The Journal

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

ISSUED QUARTERLY.

VOLUME VI.

JULY, 1912—APRIL, 1913.

EDITED BY:

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Demerara:
PRINTED BY "THE ARGOSY" COMPANY, LIMITED.

1913.

DEPARTMENT OF SCIENCE AND AGRICULTURE.

Directions to Correspondents.

Notice.—Letters should preferably be written on one side of the paper only, and as far as possible, each letter should deal with one subject only, to allow of its being referred to the officer who is concerned with the subject.

Officers should be addressed by their titles, not by their names, to prevent confusion with private letters and to ensure that official letters are opened in their absence.

Letters should be addressed—according to the nature of their contents and the business dealt with —to either

The Director,
Department of Science and Agriculture,
Broad Street,
Georgetown.

or

The Government Botanist,
The Botanic Gardens,
Georgetown.

If intended for

The Editor,
The Journal of the Board of Agriculture,

or The Economic Biologist.

or The Secretary of the Board of Agriculture,
letters should be sent to
Broad Street,
Georgetown.

Parcels should always contain the name of the sender If this is not done, it is often impossible to tell from whom they come, in the case of several arriving at the same time.

Terms and Conditions on which Crown Lands in British Guiana can be obtained for the Cultivation of Rubber under the Crown Lands Regulations, 1910.

(1.) The Governor may grant leases of areas of land of any size for the purpose of cultivating rubber thereon for a term of ninety-nine years subject to the following terms and conditions:—

(*a.*) No rent shall be payable during the first ten years of the lease but the lessee shall pay an annual rent of twenty cents an acre from the eleventh to the fifteenth year inclusive, and an annual rent of fifty cents an acre during the remainder of the lease, and in default of payment of such rent on the day on which the same is due, the lessee shall in addition pay interest thereon at the rate of six per centum per annum for each day of such default.

(*b.*) During the first ten years of the lease the lessee shall pay the sum of two cents a pound for all rubber, balata, or other substances of the like nature obtained by him from the land, whether from indigenous or cultivated trees.

(*c.*) The lessee shall each year plant one-twenty-fifth part of the land leased with rubber trees, with an average of not less than sixty rubber trees to each acre, until he has so planted not less than ten-twenty-fifth parts of the said land and shall maintain such cultivation in good order to the satisfaction of the Governor-in-Council.

(*d.*) In clearing the said land for cultivation no rubber tree or bullet tree shall be destroyed without the permission in writing of the Commissioner.

(*e.*) The lessee shall not transfer his interest in the land leased or any part thereof, save with the permission of the Governor-in-Council, but such permission shall not be unreasonably withheld.

(*f.*) If the lessee employs Aboriginal Indians, he shall keep on the tract a book, which shall be open at all times to the inspection of the Protector of Indians, the Magistrate of the District, and of any officer of the Department, Commissary of Taxation, or Officer of the Police Force and in which shall be regularly entered the name and tribe of every such Aboriginal Indian, the rate of wages allowed, and the amount paid; and all such wages shall be paid in money except with the sanction in writing (which may be either special or general) of the Protector of Indians and shall be paid (as the labourer may desire) either weekly or at the expiration of his contract, or part weekly and the remainder at the expiration of his contract;

(*g.*) The lessee shall not give or deliver to any Aboriginal Indian any spirituous liquor as an equivalent for, or in payment of, wages or for any work or labour done or performed for him by such Aboriginal Indian.

h.) The lessee shall place and keep on the façade of the land leased on or near to each boundary paal, a board or tablet on which shall be painted in plain legible letters and figures the name of the lessee, the length of the façade the compass bearings and depth of the side-lines of the

land, and the number and date of the lease under which he holds it; and the lessee shall keep such board or tablet with such inscription in good repair during the continuance of the lease; and he shall also keep the boundary lines of the land so far as he has cultivated or beneficially occupied it clear and open at all times to the inspection and reasonable satisfaction of any officer of the Department of Lands and Mines.

(*i.*) The land leased shall be subject to the right of way across any portion of it to the Crown lands aback of the said land for the officers and servants of the Crown and Government of the Colony and others thereto authorized by the Crown or Government.

(*j.*) The ease shall not confer on the holder any right to take or obtain mineral oil from any deposit that may exist in or under the land leased and all officers of the Crown or Government and other persons thereto specially authorized by the Government shall at all times have the right to enter such lands for the purpose of obtaining mineral oil therefrom: provided that the lessee shall have the right to compensation for any damage suffered by him in consequence of such entry and the obtaining of mineral oil from the said lands.

(*k.*) If the lessee pays the rent reserved and observes and performs all the covenants and conditions contained in the lease, he shall and may peaceably and quietly possess and enjoy the land leased without any interruption by the Crown or any person lawfully or equitably claiming from or under the Crown.

(2.) If any of the said terms and conditions are not complied with, or the rent is not paid, within fifteen days of the same becoming due, the Commissioner shall have the right to re-enter the land leased and take possession of the same, without paying compensation for buildings or machinery erected by the lessee on the said land.

(3.) If all the terms and conditions of the lease have been complied with, the lessee shall have the right, at any time after the expiration of ten years from the date of the lease, to purchase the land leased at the price of four dollars an acre, and on payment of the said price an absolute grant of the said land shall be made to him, and from the date of such grant the said land shall without exception be in the same position and subject to the same laws and regulations as private lands.

(4.) The fees payable for obtaining a lease, which must be deposited with the application are as follows:

	$ c.
Application	5 00
Survey—	
Areas up to 500 acres—per acre ..	30
Each acre above 500 and up to 1,000	20
Each acre above 1,000	10
These charges include labour, cutting lines, etc.	
Cost of drawing up, executing and stamping lease in Registrar's Office, say	16 20

NOTICE.

The Scientific and Technical Department of The Imperial Institute.

His Excellency the Governor desires to call attention to the advantages offered by the Imperial Institute to merchants, planters and others who may wish to have samples submitted to scientific experts for opinion as to their commercial value, etc. The following extracts from a memorandum published by the Authorities of the Imperial Institute will give an idea of the work undertaken and carried on there.

" The Scientific and Technical Department of the Institute has been established to acquire information by special inquiries and by experimental research, technical trials and commercial valuation, regarding new or little known natural or manufactured products of the various colonies and dependencies of the British Empire and of foreign countries, and also regarding known products procurable from new sources, and local products of manufacture which it is desired to export. This work is carried out with a view to the creation of new openings in trade, or the promotion of industrial developments."

2. In an extensive and well-equipped series of research laboratories, a numerous staff of skilled chemists carries out the investigation of the chemical constitution and properties of new dye stuffs, tanning materials, seeds and foodstuffs, oils, gums and resins, fibres, timbers, medicinal plants and products, with a view to their commercial utilization. Whenever necessary, these materials are submitted to special scientific experts, by whom they are made the subject of particular investigation or practical test. Reports are also obtained from technical or trade experts in regard to the probable commercial or industrial value of any such products.

3. The British Guiana Government grants a sum of £150 a year to the Department with a view to the careful investigation and commercial development of the resources of the colony.

The Permanent Exhibition Committee is collecting specimens for examination, and the Imperial Institute, which is in very complete touch with the principal manufacturing and other industries of the United Kingdom, will bring the specimens before manufacturers and others for trial with a view to their commercial development.

It is hoped that this action will do much to help in finding a market for new products and developing the market for those already exploited.

Planters and residents in British Guiana are at liberty to send (through the Secretary to the Permanent Exhibition Committee) specimens of little known or new vegetable or mineral products of the colony for examination at the Imperial Institute, by whom a report will be made through the Government Secretary. Specimens should, if possible, consist of a few pounds of the materials, and must be accompanied by full information, especially respecting the precise locality in which the material is found and the extent of its occurrence.

Attention may also be drawn to the "Bulletin of the Imperial Institute," published quarterly, which contains records of the investigations conducted at the Imperial Institute, and special articles on tropical agriculture and the commercial and industrial uses of vegetable and mineral products. Copies of this publication, price 4s. 4d. per annum (including postage), may be ordered through "The Argosy" Company, Limited.

Special sample-rooms have been arranged at the Imperial Institute for the information of inquirers in which materials which have been investigated and valued are available for reference.

Important products of the Colony are shown in the British Guiana Court in the Public Galleries of the Imperial Institute.

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VOL VI. JULY, 1912. No. 1.

More Sidelights on Agricultural Research.

In our issue of January, 1911, we published a short article on Agricultural Research, having special reference to Professor Middleton's report, in which he emphasized the necessity for decentralization in connection with agricultural work; to-day we gladly return to the topic, moved thereto by some exceedingly timely remarks made by the acting Director of the Royal Botanic Gardens, Ceylon, in the April number of "The Tropical Agriculturist." In pleading for a better understanding between practical and scientific agriculturists, Dr. Lock brings out very clearly the little Ceylon really knows, in a scientific sense, of tropical agriculture, and the great deal she has still to learn. "As regards the cultivation of the chief native products of Ceylon—paddy, coconuts, cinnamon and many others—we may safely say that little scientific knowledge of any kind exists; and if it does not exist it cannot be communicated. For the improvement of these industries, therefore, the first necessity is research, and in every one of them a variety of problems awaits solution, requiring only time and brains for their elucidation in addition to the necessary land and labour. But the brains and especially the time must be forthcoming. Hurried experiments and hasty conclusions are worse than none at all." Elsewhere he points out that he himself has been occupied during the past four years in experiments on the tapping of Hevea rubber, and is now beginning to consider himself competent to give advice on a few elementary points connected with that operation. Before those experiments were begun, it was found that no records existed anywhere which were in any way adequate for the use of an observer who wished to draw sound conclusions on the physiology of latex formation. While the Ceylon mycolo-

gist was on leave, Dr. Lock found it an easy thing to identify and recommend suitable treatment for nearly a dozen of the commonest diseases of rubber, tea, coconuts and cacao, but he draws especial attention to the fact that the information so vouchsafed represented six years' laborious study on the part of Mr. Petch. A case of time and brains. We think well enough of the average planter or farmer—who is, and must be, primarily a commercial man—to believe that he has greater confidence in steady work and scholarship than in the hurried experiments and hasty conclusions which Dr. Lock so uncompromisingly condemns. The practical man himself works by rules which he knows are the result of generation of experience; and though those rules are in nearly all cases empirical they are none the less firmly believed in and adhered to. We do not think he will grudge to Science (which is seeking to improve on the old rule-of-thumb methods by research into the law of which in most cases, the old rules are merely imperfect generalizations) that element of time which hallows so much of his own scheme of work. It must always be borne in mind that sound scientific reasons must underlie all practice, and those reasons can only be discovered by scholarly research. In America, where the practical man and the practical mind are prominent, a belated appreciation of this is already setting in. In discussing, in "Science," the function and efficiency of the Agricultural College, Mr. W. H. Jordan of the Agricultural Experiment Station, Geneva, N.Y., urges that. "It should be required of the teacher (of agriculture) as one great essential that he be a man of of scholarly spirit and attainments, and being such he should have opportunity for study and reflection. Is it not time to inquire whether we do not need a renaissance of the atmosphere of scholarship in our vocational colleges, an atmosphere that must first surround the teacher there to be breathed in by the students? Because we have been exalting the man with a so-called practical touch, possessed of the ability to edify the farming public through a pleasing way of discussing practical subjects, or who hustles about doing things, is not our vision of the scholar as an essential factor in agricultural education and inquiry somewhat obscured; and if scholarship is to be discounted in favour of qualities that make for popularity, we may well be solicitous concerning the standards and effectiveness of agricultural instruction—a statement that is equally applicable to experiment stations as instruments of research. It is a gross error to permit a young man or any man to believe that success with the people in conducting agricultural propaganda or the possession of superficially built and glibly expressed prac-

tical knowledge unsupported by a sound scientific training, constitutes an adequate reason why he should be a member of a college faculty or a station staff. Success in the energy-consuming activities of the institute platform, the fair exhibit, the railroad train or the demonstration field, is not an evidence of fitness for class room or research work. We are guilty of a false estimate of values when we place a salary premium or any other premium on success in distributing diluted information, however valuable this effort may be, as against the function and influence of the quiet and patient scholar." From South Africa comes the same cry. Dr. C. F. Juritz, M.A., D.Sc., F.I.C., in his Presidential Address to the Cape Chemical Society in Capetown, April 19th, 1912, declared that the disastrous effects of the policy of undue haste in scientific matters have more than once revealed themselves in South Africa, and for that the scientific expert has often been as much to blame as any one else—perhaps more so. Nowhere have public demands and expectations been more unreasonable than in agricultural science and nowhere has the desire to attain results which would have an immediate practical application led oftener to departure from the general principles by which all scientific research should be guided. The desire for dramatic effect, he continued, when indulged in had not only resulted in failure but it had discounted the sober ploddings of others who thoroughly recognized the principle that time is needed to develop processes and complete laborious investigations and that short cuts lead nowhere else than to immature conclusions. The thirst for sensationalism had been aroused and could not be quenched by anything so unromantic as the steady accumulation of results whose value, at present latent, would stand revealed only as the years advanced.

How Science Educates.

The main object of introducing science into schools, however, *must be* to develop character on its practical side with the purpose of teaching our youth to scout in the world—to use their eyes, to draw correct inferences, to be guided by what they see and to help themselves. From this point of view the study of method is alone of importance; it stands to reason, however, that in studying and acquiring a useful knowledge of method a knowledge of facts is necessarily also acquired.

—Prof. Armstrong in "An Appeal to Headmasters."

Entomological Notes.

By G. E. Bodkin, B.A., Government Economic Biologist.

A NUMBER of enquiries have lately been made with regard to the caterpillars that have been attacking fields of para grass, sugar-cane, etc. A memorandum about this insect has already appeared in the *Official Gazette* and reprints have been published and widely circulated.

A detailed life history of the insect, its parasites, and methods for its control is in course of preparation and will appear in a future number.

DETERMINATION OF SPECIES.

Arrangements have lately been made with Professor Newstead, F.R.S., M.Sc., A.L.S., of the Liverpool School of Tropical Medicine, to make a complete examination of the *Coccidae* or Scale Insects of British Guiana. A complete examination has never previously been made though from time to time articles have appeared in various publications on a number of species from here. It is very important that these should be worked out, and the complete list when ready will be published in this *Journal* along with a number of notes on the species, their prevalence, food plants and methods of treatment. This should prove of the greatest value, since scale insects occur commonly and cause a great amount of damage.

Arrangements have also been made with Mr. A. L. Quaintance of the Bureau of Entomology, United States Department of Agriculture, to examine the various species of *Aleyrodidae* which occur here. An article on this family, it will be remembered has already appeared in *The Journal* and Mr. Quaintance's determinations will be published later.

CLEAN CULTIVATION AS A PROPHYLACTIC.

Attention has often been drawn here to the absolute necessity of keeping all vegetation clear and free from extraneous vegetation. Mr. Edward M. Errhorn, in the *Hawaiian Forrester and Agriculturist*, Vol. IX., No. 1, January, 1912, advances some very sound arguments in favour of the practice.

"Cleanliness on a farm, in a field, or in a garden," he says, "means much to the crops or to the plants and much toward the reduction of pests. Why? Clean cultivation means cleanli-

ness; the destruction of weeds, the removal of crop remnants as soon as the crop is done; picking up and destroying dropped fruit, removing, burning up or otherwise destroying all rubbish that cumbers the ground. Experience has shown that many of our pests are protected by these very materials that we should get rid of. We very often see a grower plough a piece of land which was covered with healthy weeds and at once start to plant all kinds of small crops in the field. The seeds sprout and suddenly disappear, and Mr. Grower can't understand what is killing the plants. He calls in the Bugman, who shows him some fine fat cutworms. Nature had provided a feast of weeds for this pest, but Mr. Grower destroyed the food and planted new food. Had he any knowledge of clean cultural methods, he would not have allowed these weeds to grow long enough to attract the cutworm; also, he should have ploughed the weeds under several weeks before planting his crop, so as to starve the cutworm or prevent their development.

"Clean cultural methods, when carried out in conjunction with spraying or if carried on where the natural enemies of the various pests abound, always show a decided improvement owing to the action of two or three factors working together but clean cultural methods alone will do much toward a very good check on some of our worst pests. The old saying 'An ounce of prevention is worth a pound of cure,' is as applicable to man in relation to insects or fungi which injure his crops as to other matters which affect his well being. The enterprising grower who employs practical methods for the control of the insect pests which menace his crops has a distinct advantage over one who does not. He is enabled to obtain a good yield, while the careless grower only gets loss and disappointment. Eternal vigilance is the price of a good crop especially in a country where the summer season always prevails.

"Co-operation in the control of pests is another feature of success and should be instituted on business lines. The greatest damage to the thrifty farmer or grower is very often caused by his negligent and indifferent neighbour. It does not seem just to the clean culture grower that his next door neighbour should be allowed to breed all kinds of pests which soon find their way to his clean farm and it is not just and should be remedied.

"Steps should be taken to protect the industrious, clean-culture practising grower by regulations which can be used to make those who do not protect their own crops abate their nuisance, and thereby check the promiscuous breeding of all kinds of pests."

FOREWARNED IS FOREARMED.

We have recently received from the Experimental Station of the Hawaiian Sugar Planters' Association a very interesting Bulletin entitled "The Parasites of Insects Attacking Sugar Cane" by R. C. L. Perkins. who in his introductory remarks, makes some interesting observations on the spread of insect pests. He predicts that with the opening of the Panama Canal and fast steamers from Central America, (also British South America ?) an entirely new lot of insects will be introduced. No cane is now imported into the island but it is quite possible that insects which attack sugar-cane may be imported in other plants which they also attack. Thus, *Castnia licus*, the Giant Moth Borer, might easily be introduced into Hawaii from this country. Mr. Perkins gives actual instances which have come under his observations of the dissemination of insects from steamers. They are exceedingly interesting and fully support his predictions mentioned above.

A large number of parasites on the eggs of a Delphacid on sugar cane are described which occur in Java, China and Mexico.

A description is also given of a parasite (*Pentarthron fasciatum*) on the eggs of *Diatraea saccharalis*. It was originally obtained from Mexico by Koebele.

STALK BORERS AND DETERIORATION OF CANE CONTENTS.

We have also lately received from the Experimental Station of the Sugar Growers' Association at Porto Rico an interesting circular concerning the damage done to sugar cane juice by the Moth Stalk Borer (*Diatraea saccharalis*. Fabr.) by D. L. Van Dine, Entomologist to the Association. A series of experiments showed that there is a distinct loss in sugar and a decided reduction in the purity of the juice of canes thus infested. In Porto Rico the loss exceeds 670 lbs. of sugar per acre and that on land in which *the infestation was not apparent except upon close examination*, the yield averaging 41 tons of cane per acre and the stalks being normal and healthy in appearance. This loss increases in direct proportion to the number of joints of the cane infested by the borer, also there is more fibre and less juice in the borer-infested cane. The actual weight of borer-infested cane is less than that of sound and it is considered that the juice deteriorates more rapidly in infested cane when cane is allowed to stand without being crushed for any length of time after harvest.

CANE PESTS IN PORTO RICO.

From the same source we have received a Bulletin concerning Cane Insects by the same author on the Sugar Cane Experiment

Station. Apparently the most serious pest present in these cane fields is the Small Moth Borer (*D. saccharalis*) so well known to sugar growers in this colony.

Codyceps barberi, a fungus parasite, occurs in all districts and checks the pest to a certain extent.

Another bad pest is a May Beetle (*Lachnosterna* sp.) The larvae of the beetle feed upon the roots of the cane and the adults destroy the leaves.

A mole cricket (*Scapteriscus didactylus*. Latr.) does very considerable damage to young cane shoots. It works by eating into the seed cane, destroying the eye, and by cutting into the young shoots just below the surface of the ground. Shoots thus injured are indicated by the young hearts.

Other pests mentioned are the Sugar Cane Mealy Bug (*Pseudococcus sacchari*. Ckll.), the weevil stalk borer (*Metamasius hemipterus*, Linn.), the shot hole borer (*Xyleborus* sp.), and a number of grass worms.

FOR VINE-GROWERS.

The larvae of the Monarch butterfly (*Anosia plexippus*, Linn.) have recently been observed to feed on the cultivated Grape Vine in this colony. This, it is believed, is a new kind of food plant and brings the insect into a position of economic importance, especially as it is one of the most commonly occurring butterflies.

A Hint for "Sprostons."

In the individual cabins on river boats one usually finds the same washstand arrangement as is used on ocean-going steamers. Now this involves two separate receptacles for water, and on three diffent occasions I have found mosquito larvæ in these vessels. It is difficult, if not almost impossible, when native servants are employed, to ensure that these will be kept empty when not in use and, as stated above, they may thus be source of danger. Consequently, to obviate this risk, vessels built for use on such rivers ought to have a central water supply conveyed by pipes from a mosquito-proof tank, and have also a system whereby the refuse water could be carried off *directly* in a similar manner. It is impossible to insist too strongly on the careful supervision of all water receptacles on launches and steamers.

—J. J. Simpson, M.A., D.Sc., in "Bull. of Entomological Research": January, 1912.

A Fungus Disease of Breadfruit.

By F. A. Stockdale, M.A., F.L.S., Government Botanist.

UNDER Answers to Correspondents in Vol. III., page 128 of the *Journal* reference was made to specimens of diseased breadfruit that had been submitted for examination. Further enquiries were instituted and it was found that this disease was quite common in Georgetown and on the farms of the East Coast of Demerara. It is not unreasonable to expect that it is also to be found in other districts of the colony, but so far specimens have not yet been received from localities other than those abovementioned.

APPEARANCE OF THE DISEASE.

The disease commences as small brownish spots generally approximately circular in shape which are to be observed on the surfaces of the breadfruits. On examining this closely, it can be noticed that the centre is generally darker than the edges of these discoloured areas, and it is probable that these darker sunken areas mark where infection took place. These discoloured areas become sunken and gradually assume a darker brown hue. They usually measure about 1½ to 2 inches in diameter but cases have been observed where they measure up to 4 inches in diameter. If one of them is cut through it will be seen that the internal tissues are also discoloured and present a brownish hue, and they eventually become "water-soaked" and slimy.

The disease may affect the breadfruit at any stage of its growth, when the "fruits" are young or when they are practically ripe. Where only a single spot become affected the "fruit" may ripen and a portion of it can be used, but when the "fruits" are affected at several points they usually fall before they are ripe, and rot. If the diseased areas are examined closely when they are dark brown in appearance small pin points of a pinkish-grey colour will be seen. These on examination under a lens can be observed to be the spores of a fungus and infection experiments conducted in the laboratory have shown that these spores are produced by the fungus that is responsible for the disease. Injections that have been made in healthy "fruits" have shown that infection takes place during forty-eight hours, and that within four days the diseased sunken areas had a diameter of 1⅞ inches with an internal depth of slightly over two inches. These injections were made under aseptic conditions by means of shallow cuts

through the epidermis. How infection takes place in nature has yet to be ascertained.

The fungus that is responsible for this disease has not yet been fully worked out, but it is possible that it may prove to be a species of *Gloeosporium*. *Fusarium* spores are generally also to be found present but their relation to the disease has not been determined.

DAMAGE OCCASIONED.

The damage occasioned by this disease is considerable in some of the East Coast villages, and steps should be taken for its control. The breadfruit is a valuable food product, and a disease that causes widespread damage to it is of importance.

CONTROL.

1. All diseased fruits should be regularly collected from under the trees and buried in a hole with lime. This will prevent the spread of the disease.

2. The fruits of all trees affected by the disease should be sprayed or syringed with a 4% solution of copper sulphate or with Bordeaux mixture. The younger the fruits are sprayed the better for the results are more satisfactorily.

BORDEAUX MIXTURE.

Bordeaux mixture can be made as follows :—The 5-5-50 mixture is that generally used in this colony by the Department of Science and Agriculture and gives satisfactory results. The outfit necessary for making 50 gallons of mixture is one oil barrel, two half barrels and two buckets. In one half barrel 5 lbs. of copper sulphate are dissolved in 25 gallons of water, by suspending it in a bag that is just submerged under the surface of the water, whilst in the other half barrel 5 lbs. of fresh "quick" or temper lime is slaked carefully by adding just sufficient water to cover it. More water is added little by little until it is worked up into a thick paste. Then the balance of the water to make up to 25 gallons is added and the mixture thoroughly stirred. Equal quantities of the copper sulphate solution and the limewater are taken out in the two buckets and poured simultaneously into the 50-gallon barrel. This operation is repeated until the whole of the 50 gallons are mixed together. Stir thoroughly and then test the mixture. This is done by inserting a bright steel knife blade into the fluid for a minute or two. If it is not tarnished when it is removed the mixture has been properly prepared, but if it is coated with a reddish-coloured deposit of copper more lime-water must be

added. Bordeaux mixture should be strained before it is put into the spraying machine or otherwise the nozzles may become readily stopped up. Bordeaux mixture should always be used fresh, and therefore it is always to be recommended that only the required quantity should be made. Old Bordeaux mixture does not give good results; and so if ten gallons are likely to be required make ten gallons and only ten gallons.

SATISFACTORY RESULTS.

The breadfruits at the Botanic Gardens were affected by thi- disease in 1910, but the trouble was easily checked by the destruction of the badly diseased fruits and by spraying with Bordeaux mixture. This year there is but little disease, and this has also been checked. The success of the remedial measures recommended has been clearly demonstrated. They should therefore appeal to all farmers whose breadfruits are suffering from disease.

No Text Books.

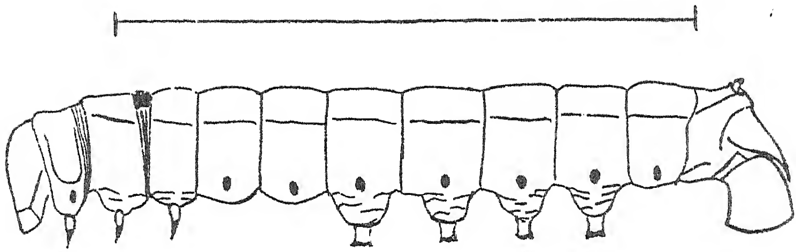
It should be unnecessary to say that books should not be used in teaching the elements of experimental science in schools—each scholar should gradually write his or her own book in such clear and simple language, moreover, that the home circle could read it with understanding and know why everything had been done and what had been discovered. A multitude of text-books are being written at the present day by persons with no qualification whatever for the office; such books are being used with most disastrous results. Most of the Nature Study pamphlets which are beng circulated introduce an entirely false point of view into the teaching. It cannot be too strongly insisted that the object in view—the training of the faculties—requires, not that information should be imparted but that information should be gained by personal observation and experimenting.

—Prof. Armstrong.

The Teacher.

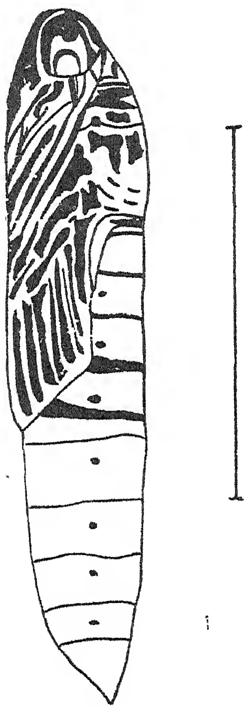
The teacher of the future must be a guide, philosopher and friend to the taught—not a mere trainer of parrots. And the work of the teacher must be held in deepest respect. But to this end, he must cut himself adrift from codes and become a self-acting reasoning being, prepared to see and use his opportunities—not a mere automaton wound up once for all at a training college.

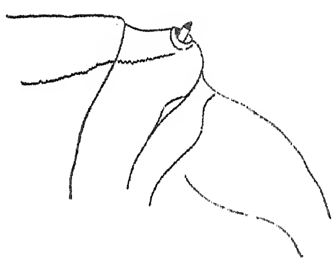
—Prof. Armsrong in "Training in Scientific Method."



Larva of *D. ello*, full grown. (Natural size of larva indicated by line.)

G. E. B. *ad nat. del.*





Dilophonota ello larva. Details of 'horn.'

Pupa case. (the line shows natural size.)

L. D. C. *ad nat. del.*

The Cassava Hawk Moth.

(*Dilophonota ello. L.*)

By G. E. Bodkin, B.A., Government Economic Biologist.

CLASSIFICATION AND HISTORY.

THIS insect belongs to the great Natural Order *Lepidoptera*, division *Heterocera* (or moths), family *Sphingidae*. The members of this family are usually readily recognised by the tapered abdomens and narrow somewhat pointed wings of the adults together with the comparative large size and characteristic horn of the larvæ.

Dilophonota ello, the *Sphinx ello* of Linnæus, was described by this famous naturalist in the year 1756 in his now historic "Systema Natura." Since then, however, it has been described by a number of Entomologists and its synonomy is as follows:

Sphinx ello, Linnaeus, 1756.
Anceryx ello, Walker, 1856.
Anceryx ello, Boisduval, 1874.
Dilophonota ello, Burmeister.

Besides these references *D. ello* is mentioned in a number of catalogues and works on the Lepidoptera, including Dyar's "North American Lepidoptera" 1902, and "The Moth Book" of W. J. Holland, 1908.

DISTRIBUTION.

Like the other members of the genus, *Dilophonota ello* is confined to the tropical or sub-tropical regions of the Western Hemisphere. It occasionally finds its way North and has been taken in Canada. Such occasions are, however, rare. It occurs as far South as Brazil, which is generally supposed to have been its original home.

In the Lesser Antilles it appears to be a comparatively uncommon insect, for with one exception* it has not been previously reported as doing damage to economic plants in this part of the world. Quite recently the "Estacion Experimental Agronomica" in Cuba has issued a Bulletin† dealing in a very comprehensive manner with the insect pests of Cassava in that island. Among the chief ones mentioned is *D. ello*, which apparently has been known there since 1870 and annually causes considerable losses in the Cassava plantations.

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* Board of Agriculture, Trinidad, Circular, "Insect notes for the year 1910-11," page 8.

† Bulletin 20. "Insectos y enfermedades de la yuca en Cuba."

In British Guiana this insect has long been known as a pest of Cassava, but only lately has it received attention owing to its repeated attacks on rubber-producing trees, particularly those of *Hevea brasiliensis.*

Three specimens appear in the local museum, two females and one male.

ECONOMIC IMPORTANCE.

The larvæ of this insect, like those of the majority of *Sphingidae,* in its latter stages of development, is capable of consuming a great quantity of foliage. This defoliation of the plant will naturally greatly retard its growth, and in the case of young plants of *Hevea brasiliensis* (where steady growth is an essential) will act as a very severe check. Up to the present it is quite the worst pest that has attacked *H. brasiliensis* in this colony and owing to its capability of existing on Cassava and a large number of uncultivated plants occurring commonly on the waste lands and in the forests in the interior, it will continue to remain a source of constant annoyance, though a severe infestation such as has been recently experienced will be rare and depend on certain conditions.

Specimens of *D. ello* have been received at this Department from nearly every rubber growing district in the colony, showing clearly that its distribution is wide.

The attacks of a pest like this (in fact most pests) in a tropical climate are greatly aggravated by the uninterrupted series of broods appearing the whole year round. Nature, however, has balanced matters evenly by providing a rapidity of vegetable growth never experienced in temperate climates. Were it not for this fact and also a very efficient parasitism, existence in tropical regions would in a short space of time become a difficult matter.

FOOD PLANTS.

The larva strictly confines its attention to the Natural Order *Euphorbiacae* and the following is a list of plants on the leaves of which it has actually been observed to feed.

Hevea brasiliensis, Para Rubber.

Sapium Jenmani; and other local rubber bearing trees.

Manihot utilissima, Cassava.

Euphorbia hypericifolia, 'Milkweed.'

Euphorbia prunicea.—another commonly occurring weed.

The N. O. *Euphorbiacae* is well represented in British Guiana and below is given a list of plants occurring both on the coast-lands and in the interior. It is quite possible that a number of these plants act as an alternative food to those previously mentioned.

Coast Lands	*Acalypha indica*, very common about Georgetown. *Caperinia castanefolia*, 'Wild Green Tea.' *Dalechampia scandens*, a creeper. *Phyllanthus distichus*, locally termed 'Gooseberries' *Alchornea nemoralis*. ,, *cordata*
Forest Lands	*Sapium cladogyne* *Sapium Jenmani*. *Sapium paucinervum*.

On one occasion in the laboratory a larva of *D. ello* was fed on the leaves of *H. brasiliensis*, *Sapium*, and Cassava. It attacked all with the same avidity and showed no partiality for any one of these particular foods.

LIFE HISTORY.

Below is given a complete typical life history of *D. ello* as worked out in this laboratory. The different stages may at times vary in some details and these will be noted where they occur, along with other observations of interest.

THE EGG.

Globular, with a diameter of 1.5 millimetres‡ and a height of 1.3 millimetres. In colour it is a bright green, closely resembling the foliage to which it is attached. The surface of the egg is shining and will on magnification be seen to be very finely reticulated. It is held in position on the leaf by a minute quantity of sticky substance deposited by the female in the act of oviposition.

DEPOSITION.

The eggs are laid singly on the upper surface of the leaf, usually in the centre or towards it. They are at times found on the stems of the youngest leaves, more especially with plants of *Hevea brasiliensis*. Owing to their colour they are at first somewhat difficult to detect, but after little practice they are quickly observed. Several eggs may be deposited by one female on the same plant.

‡ 1·5 m.m. = about 1-16th of an inch.

As the adults are only active at night the eggs are deposited at that time.

NUMBER OF EGGS LAID BY EACH FEMALE.

It has never been actually possible to determine this point, though some idea may be gained from the following facts.

At the commencement of the rains this year a number of females were captured, killed and dissected, and the number of contained eggs in different stages of maturity counted. In eleven females the average number of eggs obtained was 200. Allowing therefore for the possible destruction of the adults, parasitism, etc., in the earlier stages of existence, this gives a wide margin for the maintenance of the pest.

DEVELOPMENT.

As this proceeds dark markings begin to appear and later the form of the developing larva may be seen. The egg also loses some of its green colour. The period of time which elapses between the deposition of the egg and the emergence of the young larvæ is about five days, though it has never been found possible to make an exact observation.

EMERGENCE OF LARVA.

The young larva bites an irregular shaped hole in the side of the enveloping shell through which it emerges. When once emerged its first act is to entirely demolish the empty egg shell, leaving nothing but a shining spot where it was once attached to the leaf. It then rests for a short period.

THE LARVAL STAGE.

This occupies about 17 days though it may be slightly longer or shorter according to circumstances. During this period the larva is capable of exhibiting no less than three different kinds of colours—a light green, a very distinct red and a light grey brown. Intermediate shades between these colours are not of uncommon occurrence. The colours are not confined to any particular instar§ but may appear at any stage in the larval existence. It was thought at first that these changes of colour might be due to sexual differences, but carefully conducted experiments show that this is not the case, neither is it due to any change of food or specific food-plant. Owing to this peculiar habit several instances have occurred where differently coloured larvæ have been forwarded to

§ Instar=the stage between each 'ecdysis' or moulting of the skin.

this laboratory as being different species. Like all Sphingid larvæ they are voracious eaters and in their later stages feed incessantly unless suddenly disturbed, when they will draw in their front segments and remain perfectly still for a considerable length of time. When irritated they shake the front part of their bodies to and fro in spasmodic jerks.

Several full grown larvæ may, on a still day, be heard feeding from quite a considerable distance, the sound of their powerful mandibles cutting through the tissues of the leaf being quite distinct.

Another curious feature in the larval stage of this insect is the loss of the horn in the 4th Instar. At first it is a long and conspicuous object but later it appears as a small raised, pointed hump.*

When fully grown the larvæ vary considerably in size, and in this respect it has been observed that the green coloured ones invariably attain the greatest size (some 90 millimetres or 3½ inches in length). The brown ones come next and the red ones last, some of which only attain a length of 76 millimetres (about 3 inches).

The colours of the larvæ, the green and brown more particularly, render them inconspicuous and must protect them to a large extent from the attacks of birds and parasites.

1ST INSTAR.

The colour of the larva on emergence is a delicate shade of light green. The eleventh segment bears a long, conspicuous, black horn 3 mm. in length, which is typical of nearly all Sphingid larvæ. Its measurements at birth are :—

Length 9.0 millimetres.

Breadth 0.08 millimetres.

During this early stage it rests and feeds alternately, though it appears to feed more during the night than in the daytime. A steady increase in length is to be observed.

The period of duration of the first instar is 4 days though this may vary slightly according to circumstances. Its measurements at the termination of the first instar are :—

Length 15.0 millimetres

Breadth 1.6 millimetres.

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* See Illustration

2ND INSTAR.

After moulting its old skin the larvæ now assumes slightly different markings. The general body colour is a bright green, corresponding closely to the colour of the surrounding foliage. There now appear some little distance above the line of spiracles two thin longitudinal, lateral stripes of pale yellow commencing just behind the head and terminating at the base of the horn on the eleventh segment. The horn itself now becomes a deep red colour with a yellowish tip. Its surface is rough. The three pairs of thoracic legs are distinctly reddish in colour, while the abdominal feet are a yellowish green. The dorsal part of the body is of a darker green than the other parts. The larva at this stage commences to feed in earnest taking only occasional rests.

Its measurements at the end of the second instar are as follows :—

Length, 30.7 millimetres.

Breadth, 4.6 millimetres.

The duration of this instar is about 4 days. During the latter part indistinct red markings appear on the 3rd thoracic segment, and these gradually become more distinct.

3RD INSTAR.

The light green colour of the body is still unchanged. The two lateral yellow stripes are more marked than in the previous instar, and are produced down each side of the head. They are further accentuated by the appearance on their upper edges of a very fine black stripe. The spiracles are "picked out" in white with the centre portions darkened. Both the thoracic and abdominal feet now appear reddish in colour. The markings on the 3rd segment which became visible during the later stages of the previous instar are now clearly defined. They consist of a small transverse band of dull red with a number of light carmine spots with one, central, large, almost black spot. These are more clearly shown when the head and thoracic segment are stretched out.

The duration of this instar is 4 days. Measurements taken at the end of the 3rd instar are as follows :—

Length, 48.5 millimetres.

Breadth, 7.3 millimetres.

4TH INSTAR.*

In this instar the entire body colour of the larva becomes changed. The general colour in now reddish brown. A subdorsal row of 14 dark spots placed at regular intervals now appears. The spiracles remain the same as in the 3rd instar. The head and first two thoracic segments are somewhat lighter in colour than the rest of the body and the markings on them are more distinct. The lateral yellow stripes exhibited in the previous instars are now not so distinct. The horn has now disappeared and its place is taken by a slightly raised 'hump' which is dark-coloured with a ring of lighter colour near its apex. The thoracic and abdominal feet are reddish and ringed with black at their respective joints.

The duration of this instar (from commencement to beginning of quiescent stage prior to pupation) is about 4 days. The measurements at the termination of this instar are as follows :—

Length, 80.0 millimetres.

Breadth, 10.0 millimetres.

As a general rule in this instar the green coloured larvæ keep the same colours and markings as in instar 3, while the brown larvæ exhibit the same markings as the one described. At the end of this instar the larva ceases to feed and becomes restless. Bred in captivity, they wander about the cage in an aimless manner. In nature, however, they descend the plant on which they have been feeding and search for a convenient place in which to pupate. The spot selected is either just beneath the surface of the ground in a crack or similar hiding place, or in a rough cocoon on the surface of the ground formed by drawing together a number of dead leaves or rubbish by means of coarse brown silken threads.

When a spot has been selected and the cocoon formed, the larva becomes quiescent and commences to lose its colour and looks unhealthy generally.

Considerable shrinkage takes place and a quantity of greenish fluid is exuded; later, continual jerking movements of the body are made. It finally stiffens, the larval skin is cast off and the insect enters the pupal stage. The stage prior to pupation occupies 3 days.

THE PUPA.*

When first formed the pupa is soft and greenish in colour but in a short space of time the abdomen and finally the upper portions harden and the natural colour and markings are assumed.

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* See Illustration.

In appearance it is slightly elongate, smooth and shining. The general colour is chestnut brown in different shades, ranging from almost black to the other extreme. The wing cases are striped longitudinally with dark lines, and the body segments are marked with alternate transverse bands of light and dark chestnut brown.

When disturbed, the abdomen is jerked sharply from side to side.

The measurements of the pupa are as follows:

Length, 45.0 millimetres.

Breadth, 10.5 millimetres.

The pupal period ordinarily lasts about 12 days though it may be influenced by weather conditions. Before the emergence of the adult the pupa darkens in colour and softens considerably.

Emergence from the pupa invariably takes place at night and is effected by longitudinal ruptures along the edges of the wing cases. As soon as the adult emerges it crawls up the nearest plant and rests till its wings have properly dried and hardened.

THE ADULT.

The adult of *Dilophonota ello* has been described by a number of naturalists (see references at commencement of this article) and for a technical description these may be referred to.

The following is a simple description by means of which the moth should be easily recognised.

The upper wings and thorax are light grey brown in colour while the under wings are a bright red gold edged with black.

The abdomen bears five distinct transverse black bars (the remains of a sixth may be traced in some specimens) these contrast strongly with the light grey brown of the rest of the abdomen.

The male is distinguished from the female by the upper wings bearing a central longitudinal, irregular line of dark marking, commencing at the base of the wing and reaching to the apex.

When at rest during the daytime the moth becomes an inconspicuous object owing to its colouration and markings.

The females are more abundant than the males in the proportion of about 2 to 1.

The measurements are as follows:—

Average wing expanse, 95.0 millimetres

Average length of body, 40.0 millimetres.

HABITS.

As is usual in this division of the Lepidoptera the perfect insects are entirely nocturnal in their habits and seem to be readily attracted to a bright light. In normal years they are frequently met with, and *D. ello* is perhaps the commonest Hawk Moth met with in the colony. Recently it has appeared in enormous numbers and the resulting generation of larvæ has done considerable damage to crops. This "swarm," as it may be termed, was quite a curious phenomenon, though peculiarities of insect life are by no means rare in British Guiana.

The adults were first noticed at the commencement of the rains this year after a drought of extraordinary severity. They appeared in large numbers around the electric arc lights in Georgetown and some idea may be gained of their numbers from the fact that on the night of May 14th no less than 30 specimens were obtained in five minutes around one light and that without any great effort or search. They continued to appear in this manner for close on a week, and for some time afterwards were observed about the lights though not in such large numbers. Towards the middle of June an infestation of the larvæ took place, reports being received from all quarters of their prevalence.

The origin of the swarm is wrapped in considerable mystery. The most probable explanation seems to be that a kind of hibernation in the pupa form took place during the very severe drought experienced, on the advent of the rains and consequent increased energy of plant growth emergence ensued. It is certain that all insect life during the drought was very considerably reduced, and many cases parallel to that of *D. ello* may be quoted where the commencement of the wet weather resulted in an enormously increased activity.

PARASITES.

Up to the present two different kinds of parasites have been observed to act as a check on *D. ello* in British Guiana. The one, an egg parasite, is probably the most efficacious, while the other—a Dipterous parasite on the larvæ—is not commonly met with.

The egg parasite is a tiny Hymenopterous insect belonging to the family *Proctrotrypidae* and each egg is capable of producing as many as seven to eight perfect specimens of this beneficial little insect. Many of the eggs of *D. ello* have been discovered thus parasitised, and they may be recognised by the fact that the egg shell is left intact, a small circular hole in the side of the shell

showing that the parasites have emerged. The larva of the moth, it will be remembered, entirely demolished the egg-shell after it had emerged.

This parasite has recently been described* by Peter Cameron, and he has named it *Telenomous dilophonotae*. His description is as follows :—

Black, the apex of the coxæ narrowly, trochanters, base and apex of tibæ and the and the tarsi whitish yellow. Wings hyaline, the nervures pallid, testaceous. The antemæ are not quite black, having a fuscous tint, the six apical joints forming the club are clearly separated, the basal one smaller than the others, the apical conical, the others wider than long, the basal 2 joints of the flagellum longer than wide, the other shorter, as wide as long, smooth shining almost bare. The eyes large projecting, abdomen longish, ovate, wider than long, striated to the 2nd segment smooth. Female. Length hardly 1 m.m.

The parasite on the larvae is a Dipterous insect belonging to the family *Tachinidae*, whose parasitic tendencies are too well known to be discussed here.

Larvæ thus attacked may be recognised by their peculiar semi-paralyzed movements and curious " flabby " appearance. These symptoms are an almost sure sign of the presence of Tachinid larva developing within the unfortunate caterpillar, which will continue in this state till the vital parts of the body are attacked and death naturally ensues. The fly itself is a large one ; it has not yet been identified.

Other yet undiscovered parasites doubtless exist, especially those belonging to the Order *Hymenoptera* which in course of time may be recorded. In Cuba an Ichneumon (*Microgaster flaviventris*, Cresson) acts as a check to this pest.

No instance of birds feeding on these larvæ (though it is quite within the bounds of possibility) have been observed. This no doubt is due in many cases to their protective colouring.

MEHODS OF CONTROL.

The control of this pest is by no means such a difficult matter as may be supposed, given the necessary weapons and the means of using them. First and foremost in this respect is the use of Lead

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* On the Hymenoptera in the Georgetown Museum—" Timehri " The Journal of the Royal Agricultural and Commercial Society of British Guiana, 1912.

Arsenate, which in the form of a solution with water is sprayed on to the leaves by means of a spraying machine. Experiments with young plants of *Hevea brasiliensis* have shown that the best mixture is one consisting of the following proportions—lead arsenate 4 lbs., water, 50 gallons. This is very effective, quickly poisoning the larvæ, and showing no tendencies to scorch the leaves.

Failing the use of this insecticide, Paris Green or dry powdered lead arsenate may be *lightly* dusted on the leaves when they are damp, which ensures its more perfect adherence. These insecticides, although being quite as effective as the above mentioned mixture, will not adhere to the leaves for the same length of time.

As the application of poisonous compounds is not always possible, the following means of control, which may be termed "common-sense methods" should be exercised as *soon* as damage is noticed.

The larvæ are conspicuous objects and may thus very easily be destroyed by hand-picking. The eggs also may be looked for and destroyed, the ones which are parasitised (they turn black in the later stages) being kept in a closed vessel and the parasites on their emergence released. Parasites on the larvæ, when observed, may be treated in the manner indicated. Search should also be made for the pupae around the bases of the plants, in decaying vegetation, etc.

NOTES ON SPRAYING.

As spraying is a comparatively new operation to most agriculturists in the colony the following practical hints are given as a guide to those who are inexperienced.

A "mist-like" effect should be aimed at when spraying, and this is obtained by keeping up a good pressure, using a "Vermorel" nozzle and standing the proper distance away from the plant, The more finely divided is the spray the better it will cover and adhere to the leaves. Spraying should be stopped as soon as the spray is seen to drip from the leaves. Spraying should not be carried out in the hot mid-day sun. Care should be taken that the solution is kept well agitated as lead arsenate is a heavy substance and soon sinks. A dry day should also be chosen so that the solution may have time to dry. When once dry it will remain on the leaves for a considerable period.

NOTE.—Since this article was written the Proctotrypid egg parasites have been observed to occur in large numbers, and there is little doubt that the second generation following the first exceedingly prolific one mentioned in this article was greatly checked by them. Eggs of *Dilophonota ello* collected in a number of widely separated districts have all been found to be parasitized.

Control of the Cassava Moth and the Grass Moth.

On June 20 last, the following notice was published in *The Official Gazette* :—

The attention of cultivators of Rice, Rubber and Cassava is drawn to the following insect pests which at present are extremely prevalent in the colony and threaten the above crops.

1. The Cassava Hawk Moth (*Dilophonota ello.*)
2. The Grass Moth (*Remigia repanda.*)

THE CASSAVA HAWK MOTH.

The larva or ' worm ' of this Sphinx Moth feeds on the following economic plants—cassava, Para rubber, *Sapium Jenmani*, also a number of weeds belonging to the family Euphorbiacae, chiefly that commonly known as 'Milk Weed.'

The eggs are laid separately on the upper surface of the leaves and may, with a little practice, be easily detected. They are green in colour, globular and about 1-16 of an inch in diameter.

The worm in its later stages of development attains a length of some 3 inches and varies very considerably in colour, some being bright green, some distinctly red, and others again a dull brown. When full fed (which takes about 16 days) the worm descends to the ground and changes into a chrysalis beneath a rough cocoon composed of dead leaves, vegetable matter, etc., drawn together with coarse silken threads. The chrysalis is chestnut brown in colour with darker markings.

The Moth itself is a light grey-brown in colour, the under-wings being a bright-red gold with dark edging.

The abdomen bears five distinct transverse black bars, these contrast strongly with the light grey brown of the rest of the abdomen.

REMEDIAL MEASURES.

Spraying the plants with Lead Arsenate at the rate of 4 lbs. Lead Arsenate to 50 gallons of water is effective as it quickly poisons the worms. Paris Green may be lightly dusted on the leaves, when slightly damp so as to ensure its adherence. It also is an effective poison. Failing these methods the worms should be handpicked

from the leaves as they are easily seen. Search may also be made for the eggs and pupae. These measures should be carried out at once to prevent further damage to the cultivations.

THE GRASS MOTH.

The larva of this moth attacks sugar-cane blades, rice, para-grass and the majority of the commonly occurring grasses.

The eggs are very small (considerably less than 1-16 of an inch in diameter), of a green colour, and laid on the blades of the grasses.

The worms may easily be recognised by their smooth hairless appearance and habit of forming a loop in their bodies when walking. The upper surface of the body is almost black with faint longitudinal white lines and along the sides are a number of very fine stripes of brown and yellow. The head is striped with fine lines of black and yellow. The under-surface of the body is dark coloured. It measures just over $1\frac{1}{2}$ inches in length when fully grown.

When fully fed the worm moves to some plant near by and forms a cocoon in one of the leaves by drawing together the edges with fine silken threads, it then turns into a chrysalis. At times they will form a cocoon on the plant they are feeding on.

The chrysalis is dark brown in colour and covered with a kind of grey powder which may easily be rubbed off.

The moth is inconspicuous, light grey brown in colour with two distinct transverse dark lines across the upper wings.

REMEDIAL MEASURES.

When attacking cane blades these may be sprayed with Lead Arsenate or treated with Paris Green in the manner previously described.

A careful watch should be maintained for the appearance of this pest on rice, for when once a foothold has been established it will speedily destroy the entire crop.

Lead Arsenate cannot be applied to this crop with any effect, as it will not adhere to the blades, and Paris Green scorches so as to make its use entirely out of the question.

Handpicking is the best method of dealing with them, also as their cocoons are easily seen they should be looked for and destroyed. Traplights placed low on the ground should account for a number of the adults.

G. E. BODKIN,
Government Economic Biologist.

Sapium Cladogyne, Hutchinson.

A Newly Described Rubber-Producing Sapium.

The following occurs in the Kew Bulletin No. 5, 1912, regarding specimens of Sapium that have been submitted to Kew for identification :—

" In December, 1910, a series of specimens of Sapium collected by Mr. F. A. Stockdale, Assistant Director of Agriculture, and others in British Guiana were communicated to Kew by Prof. J. B. Harrison, Director of Agriculture, for comparison with the type *S. Jenmani*, Hemsl.

" A careful examination proved that two species were represented, which, although apparently identical in their vegetative parts, could be distinguished by a remarkable and interesting difference in the form of the inflorescence. Mr. Stockdale calls attention to this difference in a paper on the " Indigenous Rubber Trees of British Guiana," published in *Timehri* : The Journal of the Royal Agricultural and Commercial Society of British Guiana, January, 1911, p. 24.

" In *S. Jenmani* as shown by Hemsley's figure in Hook. Ic. Pl.t. 2649, which we regard as representing the type of the species, the inflorescence is unbranched and the female flowers are disposed for some distance along the lower part of the rhachis, the upper part being male. The flowers of both sexes are evidently mature about the same time, or they are perhaps slightly protogynous. In *S. cladogyne*, the name proposed for the new species, however, as pointed out by Mr. Stockdale, the inflorescence consists of a central spike with two very short lateral branches at the base which bear the female flowers. During the flowering stage of the male these female branches are detected only by close examination. The female flowers evidently attain maturity a considerable time after the fall of the male, the axis bearing the latter soon articulating at the base and leaving a large scar which can be plainly seen in the young and also in the mature fruiting stages.

" It appears to the writer that this difference in the time of flowering of the two sexes constitutes another important character serving to separate the species, for in *S. Jenmani* it is highly probable that pollination is affected by male flowers from the same

individual whereas in *S. cladogyne* this is obviously not possible. Field notes on this point would be of interest.

" In a communication received by the writer in October, 1911, Mr. Stockdale states that since his paper was published in the Journal quoted above it has come to his notice that the latex produced by plants of the new species (*S. cladogyne*) is somewhat different from that obtained from *S. Jenmani* but that complete analyses had not then been made. He adds the important fact that the growth of young trees of the two species under cultivation is decidedly different, the primary branches of *S. Jenmani* being directed upwards and forming an acute angle with the stem, whilst in the new species (*S. cladogyne*), the branches spread almost horizontally. He further states that the colour of the leaves is darker in the latter species."

Sapium cladogyne exists with *S. Jenmani* on Fort Island and at the Bonasika Rubber Reserves, Essequibo River, and has been planted with *S. Jenmani* on the rubber properties in the North Western District and at the Issorora Experiment Station.

F. A. S.

The Monetary Losses Caused by Insects.

Economic entomology, based upon abstract work, shows an annual money loss occasioned by insects as follows :—

Cereals	$ 300,000,000
Hay and Forage	66,500,000
Cotton	85,000,000
Tobacco	10,000,000
Truck Crops	150,000,000
Sugars	9,500,000
Fruits	30,000,000
Farm forests	11,000,000
Miscellaneous Crops	10,000,000
Animal products	300,000,000
Natural Forests and Forest products ..	100,000,000
Products in Storage	200,000,000
Total	$ 1,272,000,000

—Presidential Address at the Centenary of the Association of Nat. Sciences of Philadelphia. (" Science " April 5, 1912.)

Lessons with Plants in British Guiana.

"*It is finding answers to questions which chiefly deserves to be called Science.*"—L. C. MIALL, F.R.S., in "Teaching and Organization."

(*By the Science Lecturer*).

V.

DICLINOUS FLOWERS AND DIŒCIOUS PLANTS.

IF you have conscientiously followed out the directions given you in previous articles of this series you should now be in a position to examine most plants that you come across with confidence and to describe them with a fair amount of accuracy. We shall now deal with the subject more generally and leave to your own diligence the examination of the details already touched on.

A SUCCESSFUL PLANT.

One of the commonest weeds in Georgetown is the climbing plant usually known as the "Baby Cucumber." It presents several points of interest. The remarkable vitality of its seeds is one. Several interesting experiments can be made with these. Throw a few down anyhow on damp soil in a cool corner and watch them carefully, or grow them on damp paper or cloth on a plate and observe how the radicle emerges from the seed-coats and how the cotyledons or seed-leaves work themselves free, lift themselves in the air, turn green and grow as they act as ordinary leaves. Vary the conditions of your experiments and study the growth of the *living* plant and you will soon get a clear idea of the remarkable hardiness of this plant and of its wonderful powers of reproduction, and you will be able to understand why it is that it is so successful in the struggle for existence. The reason why it spreads so widely and springs up so persistently and in such out of the way corners is not perhaps quite so obvious, but we may give you a hint which may help you. What colour does the fruit turn when it ripens, and how many perfect ripe fruits will you find on any one vine ? In other words, how long does it take the birds to discover the ripe fruits and what kind of bird is most fond of them ? And how exactly do the birds distribute the seeds ?

HOMOLOGY.

Another interesting point is the means by which the plant manages to clamber over all other plants in its neighbourhood,

robbing them of light and air and thriving at their expense. When you have discovered the *tendrils* note carefully what the young ones look like and compare them with the older ones; find one which has secured a good hold and has twisted itself into a spiral and follow the thread along its whole length, noting any peculiarity in the twist a you do so; and then try and worry out for yourself the *homology* of the tendril—that is to say, try and reason out what the organ, from its position, nature, and origin may be supposed to represent. As this is a new idea we may explain a little more fully. We have already come across many kinds of leaves—foliage leaves, floral leaves, reinforcing leaves, bracts, scale leaves,—and these are all *homologous*: they resemble each other in their origin and in their relation to other structures such as buds. So if the tendril arises at a node and bears a bud in its axil, that will be an argument in favour of its being homologous with the leaf or with a part of the leaf. Look at the leaves of the *Gloriosa superba* or Corkscrew Lily and at the climbing organs of that curious plant the Catsclaw Bignonia. On the other hand if he tendril arises in the axil of a leaf it may be homologous with a branch, and this argument will be strengthened if the tendril shows signs of dividing, and especially if it bears tiny scales which would be homologous with tne leaves on a branch.

A study of the common Corallita will be instructive at this point especially if you add the examination of another common climber, *Vitis cissioides*. This plant does not seem to have a popular name in the colony, but it is a frequent companion of the Baby Cucumber, covering palings, out-houses and hedges with its cordate, sharply serrate leaves and tiny pale-yellow blossoms borne in inflorescences which bear a curious resemblance to those of the English ivy. If you have followed this article carefully you should have little difficulty in gaining a reasonable idea of the homology of the tendrils in this *Vitis*, and this should help you to interpret such tendrils as those of its cousin, the grape vine, which may come under your observation. While studying tendrils do not forget to note just at what stage in the growth of the plant the tendrils first appear. The development of the leaves and of the climbing part of the plant in the 'Baby Cucumber' will repay close investigation.

IMPERFECT OR DICLINOUS FLOWERS.

Now devote your attention to the flower. The outer whorls will present no difficulty, but what of the central portion? So far you have been led to expect a whorl of stamens and a central pistil in the flower; but what do you find in this case. Ex-

amine the stuctures you find very carefully, cutting the flowers lengthwise and looking for ovules which will indicate the presence of an ovary and for pollen-dust as a sign of anthers. Do you find both ovules and pollen dust in tne same flower ? If you find only one, examine other flowers for signs of the other. Are all the flowers on one plant alike in this respect ? Thus we arrive at the notion of imperfect or *diclinous* flowers which contain only one of the essential organs and may be called *staminate or pistillate* accordingly. More, we find there may be such things as plants which bear nothing but flowers of one or other of these kinds—*diœcious* plants. The idea is no doubt already familiar to you, for we suppose that everybody in the colony knows that the 'old man' papaw tree, with its beautiful hanging festoons of flowers, bears no fruit and that productiveness is confined to the female papaw tree, which bears blossoms of quite another character. Any one, too, who has cultivated melons or pumpkins or squashes must have noticed the first flush of barren blossoms which precedes the setting of fruit; but in that case the flowers are diclinous but the plant is *monœcious*, for it bears both staminate and pistillate flowers.

THE STRUGGLE FOR EXISTENCE.

With these facts to guide you you should examine the castor oil bush, the palms in the Botanic Gardens, the Sandbox tree, and the various 'milk weeds,' such as the "Flaming Bush" whose scarlet leaves and curious flowers form so brilliant a picture at certain seasons of the year. A particularly fine one grows in the grass plot under the 'Bat tree' in the ornamental gardens of Colony House, N.A. Let us take the castor oil plant first. The inflorescences are very simple but striking and you will have no difficulty in determining which are the staminate flowers and which the pistillate. But which ripen first; and do you find receptive stigmas and ripe anthers in the same inflorescence or is the fruit set before the stamens are mature or *vice versa*? This difference in the time of ripening of the essential organs is a common phenomenon among flowers and is known as *dichogamy*. Darwin's researches on *cross-pollination* have given us the idea that plants of a given species benefit by having their flowers fertilised by pollen from different plants or even from different inflorescences on the same plant. The plant itself gains no advantage, but its progeny, springing from the seeds which are the result of cross-pollination, are stronger and hardier and (possibly by having a greater tendency to vary) may have a better chance in the struggle for existence which they have to face. You must

remember that Nature seems to regard the individual as of small importance but the race as everything. A moment's reflection will make you realise that hundreds of seeds must perish for every seedling that gets a fair start in the world and that each mature tree in the forest, for instance, is but the survivor out of a family of many thousands.

NAKED FLOWERS.

The castor oil flower will possibly puzzle you by its lack of floral whorls; but having tried to ascertain how many whorls are represented you may pass on to its relation the Sandbox, another member of the great family *Euphorbiaceæ* which is so common and so important in the colony, including as it does such rubber-producing trees as *Sapium Jenmani* and *Hevea brasiliensis*. Look at the ends of the branches of the Sandbox for flowers and do not be disconcerted if you find them very different in appearance from the flowers we have been dealing with hitherto. Careful examination will soon make things clear in this instance as in the other cases we have tackled. It does not seem impossible that *reduction* of the floral whorls may occur wholly or partially, that there should even be naked flowers and that such flowers should be diclinous. Recall the branched stamens of the castor oil and the characteristc wheel-shape of the ripe Sandbox fruit, and use your knife freely to cut sections, and you will have no difficulty in interpreting the flowers before you.

Now we come to a real difficulty. The inflorescence of the Flaming Bush—another Euphorbia—is certainly quite different to anything we have come across yet. Nevertheless we may remember British Guiana's motto, "friten nutten" and proceed to examine it carefully *secundum artem*. The great gaping yellow structure evidently secretes something attractive to insects—a Flaming Bush in full flower is a perfect hunting ground for entomologists—and we may put it down as some glandular secreting structure similar to the nectaries we have already observed in the course of our studies. A three-lobed, fruit-like body bearing six feathery projections and borne on a curved stalk we shall be safe in interpreting as a pistillate flower similar to those we saw in the castor oil plant. This pistillate part appears to arise from a small forest of stamens; and stamens they certainly are for each bears an anther with pollen dust. But closer investigation will reveal a tiny scale or bract upon what appears to be the filament, and for this reason each of these apparent stamens is considered to be a naked staminate flower homologous with the staminate flower

of the Sandbox. The "flower" of the Flaming Bush then is interpreted as an inflorescence—a peculiar kind of head consisting of a cluster of staminate flowers surrounding a single pistillate flower and reinforced by a ring of fleshy bracts bearing glands. Botanists have given it the name of *cyathium*, and it does not seem likely that we can improve on that. In our next article we hope to have something to say regarding other forms of flower clusters known as 'heads' or *capitula*.

(*To be continued*).

More Progress.

As in the older West African Colonies, malaria is by far the most prevalent insect-borne disease in Northern Nigeria, but of recent years the number of cases has been gradually diminishing owing in part to the extensive use of quinine as a prophylactic, and further to the measures adopted to effect a diminution in the number of mosquitos. The importance of the latter is now universally recognised, and much effective work has been done in this direct tion by the Medical Department. In order to strengthen its position in this matter, legislation is necessary so that when once the sanitary officer has directed attention to any deficiency it should be made a punishable offence if this is not remedied within a reasonable time.

—J. J. Simpson, M.A., D.Sc., in "Bull. of Entomological Research": January, 1912.

An Old Friend in New Quarters.

The roselle ("sorrel"—*Hibiscus subdariffa*) is an annual related to the cotton and okra, and is probably the only plant in the world whose calyces are utilised for food. The plant flowers in October and the rapidly developing fleshy calyces are picked and used in making sauces, jellies, or jams, very similar in flavour to those made from the cranberry. A good wine is also made from the calyces. A very agreeable cooling drink may be made from the leaves and tender twigs, steeped in boiling water. In India the roselle is grown principally for its fibre. The many useful qualities of the roselle and the ease with which it may be cultivated are sure to make it a favourite among all classes as soon as it became known in the Philippines.

—"Philippine Agric. Review": Oct., 1911.

The Principles of Paddy Manuring.

By W. H. Harrison, Agricultural Chemist, Department of Agriculture, Madras.

I.

In the manuring of crops many factors come into operation and it is only after a careful consideration of these that a manure suited to the needs of a crop and the soil on which it is grown can be selected. The chemical and physical properties of the soil, the particular requirements of the crop grown, the type of soil and the methods of cultivation employed are among the most important factors to be taken into account and as many of these apply with particular force to paddy cultivation, they determine to a very large extent the kind of manure employed and the manner of applying it.

Paddy cultivation as practised in Southern India differs essentially from ordinary cultivation in (1) that the land is prepared for the reception of the crop by a system of puddling and (2) the land is kept flooded and therefore saturated with water during the greater part of the growing season. These two factors dominate the whole of the conditions under which paddy is grown and their effect on the soil and the plant must receive careful consideration if the manuring of paddy is to be placed on a rational basis.

The puddling of paddy land previous to transplanting affects the physical condition of the soil mainly by bringing about the disintegration of the soil particles and thus increasing their number and producing a finer and more clayey texture. This effect is not confined to the first few years after a soil is brought under paddy, but continues so long as the land is thus utilized, so that unless counteracting influences are brought to bear, a paddy soil tends to become heavier in character as years go on. This is well shown by certain analyses carried out at Chaganoor in the Bellary district. Here the ordinary dry soil bordering some isolated paddy fields contained approximately 13 millions of particles in every grain of soil, whereas the land which had been under paddy cultivation for about four years contained 14⅓ millions and land which had long carried paddy crops 20⅓ millions. Further, it is an invariable rule that paddy land has a finer texture and heavier character than the surrounding dry lands. The fact that paddy cultivation produces a heavier and closer soil being thus demonstrated, the

first problem which presents itself in the manuring of such lands is the question of using manures which will tend to counteract this effect. Should the object aimed at in manuring be to produce a lighter and coarser soil and so counteract the effects of the methods of cultivation or should the manure act by accentuating these effects?

THE PHYSICAL EFFECT OF MANURES.

This problem can be solved by employing the principles which apply to dry land farming. Here certain manures cause the very fine particles of a soil to become cemented together to form compound particles, thus producing a coarser texture and a lighter soil, whereas another set of manures have the opposite effect and by destroying the compound particles already existing in a soil a finer texture is produced. To the former class belong those manures which contain large quantities of organic matter and which on undergoing change in the soil yield humus, a substance which has a decidedly beneficial effect on the texture of soil. In the latter class may be placed many artificial manures of the type of ammonium sulphate, etc.

By applying representatives of these two classes to a paddy soil and contrasting the relative effects on the crops, it is possible to arrive at a general conclusion. Such an experiment has been in operation on the Central Farms, Coimbatore, for several years, in which the effect of a green manure was tested against similar land to which a mixture of bone-meal and potassium sulphate was applied as a manure. As in both cases, nitrogen, phosphoric acid and potash were added to the soil with the manures applied, such an experiment gives directly the effect of the bulky organic manure. With daincha as the green manure crop, a yield of 4,200 lbs. of paddy was obtained, with wild indigo about 1,300 lbs. and with calotropis leaves 3,877 lbs., whereas the comparison plot only yielded 2,652 lbs. Another plot to which another type of bulky organic manure was added, namely, castor-cake, yielded 3,550 lbs. of paddy. Thus the addition of a bulky organic manure to a paddy soil gives better crops than a manure containing little organic matter, but which has approximately the same manurial value. Consequently it may be stated that the first essential of a paddy manure is that it should contain a large proportion of organic matter capable of producing humus, thus counteracting the tendency of such soil to become finer in texture and heavier in character.

THE NITROGEN FACTOR.

Taking the next factor, the fact that the land is kept fully saturated with water throughout the greater part of the growing seasons

means that there is practically no free oxygen present in the soil and this draws at once a sharp distinction between paddy cultivation and that of ordinary field crops. The presence or absence of air in a soil determines to a very great extent the course of the changes undergone by the nitrogen in a manure before it is incorporated with the plant tissues, and in ordinary soils the nitrogen of the manure after undergoing many intermediate changes unites with the oxygen of the air to form nitric acid, a substance which is easily absorbed by the crop and the nitrogen it contains easily utilized for the purposes of the plant. On the other hand in paddy soils no oxygen being present, instead of nitric acid, ammonia is produced, but it has been shown in Japan that the paddy plant readily assimilates this substance and consequently the product of the decomposition of many manures in such soils are suitable for the needs of the plant and there is no need to endeavour to alter the ordinary course of affairs in this respect.

Fermentations which take place in the absence of free oxygen are known as anœrobic fermentations and that this is the type of fermentation which takes place in paddy soils is shown by the composition of the bubbles of gas which are evolved. The gases found are the same as those obtained from marshes and bogs where the fermentation is known to be anœrobic. Under these anœrobic conditions, nitrates are decomposed and the nitrogen they contain liberated in the free state, a form in which nitrogen is of no value as a plant food to paddy as well as to all cereal crops and consequently manures containing nitrates should not be used for the manuring of paddy.

NITRATES V. AMMONIUM SALTS.

Further as these soils are kept saturated with water any substances which are soluble in water and which are not retained by the soil are liable to be wasted away and lost and nitrogen when in the forms of nitrates is particularly liable to be washed away. On the other hand, the danger of loss by washing away ammonia is very slight, for although the substance is very soluble in water, the soil has such an attraction for it as to remove it from solution and so prevents any loss by leaching occurring. These considerations lead to the conclusion that nitrates in any form are not suitable manures for paddy, whereas ammonium compounds or substances which yield ammonia under anœrobic conditions are useful and actual experiment at Coimbatore has shown that calcium nitrate and saltpetre are of little value when applied to a paddy crop.

The factors discussed above have, so far as manurial ingredients are concerned, dealt only with the utility of the different forms of nitrogen, whereas all manuring must have reference to the supply of potash and phosphoric acid as well.

Paddy being a cereal, the general requirements of that class apply in so much as those crops respond to the application of nitrogen and phosphoric acid, and these manurial ingredients are therefore the ones most generally used, whereas potash is usually only applied when the soil is known to be deficient in that respect.

POTASH.

Thus, broadly speaking, in manuring these crops attention is primarily paid to supplying an adequate amount of nitrogen and phosphoric acid, the supply of potash only receiving a secondary consideration. That this holds good for paddy is shown by the results of manurial experiments carried out in the Godavari and Kistna Deltas and at Coimbatore for out of seven experiments the use of nitrogen and phosphoric acid gave an increased yield over nitrogen alone and further in five of the cases, the addition of potash actually produced a decreased yield. For instance, at Coimbatore, nitrogen (in the form of a green-manure crop) and phosphoric acid gave a yield of 3,733 lbs. of paddy and 4,043 lbs. of straw per acre, whereas, nitrogen, phosphoric acid and potash gave only 3,294 lbs. of paddy and 3,228 lbs. of straw. Thus the need for supplying potash in paddy manuring is comparatively unimportant and is determined chiefly by the character of the soil on which the crop is grown. This is an exceedingly fortunate result to obtain, for potash is expensive and consequently the fact that its use can usually be dispensed with decreases very greatly the cost of manuring. It is true that in these experiments the use of a comparatively large amount of potash has often led to a large increase in yield, but in these cases, the cost of the manure supplied has often been greater than the increased value of the crop obtained and has in fact resulted in a small loss to the cultivator.

The position arrived at so far may be summarized as follows :—

1. Paddy soils need manuring with bulky organic manures which readily decompose under anœrobic conditions yielding humus.

2. Nitrates are unsuited for the purpose, whereas ammoniacal manures or manures which yield ammonia under anœrobic conditions of fermentation are of great value.

3. Nitrogen and phosphoric acid must be applied to all paddy soils, whereas potash should only be applied when the soil is in particular need of that ingredient.

(To be Continued.)

Hints, Scientific and Practical.

Technical Education in India.

THE cry for technical education does not come from the class really interested in becoming craftsmen, but from the class—no blame to them—whose tradition is against manual labour, in Bengal called the *bhadi-log*. Their ambition is not to become craftsmen but supervisors, learning theoretically in order to direct the manual labour of others. They are not yet sufficiently instructed to know that we, whom they see in the position of directing others' labour, had to pass through the mill of hard manual labour ourselves. If an English or Scottish lad is intended for the engineering trades he has as a beginning to serve his apprenticeship working at bench and lathe side by side with the actual wage-earning workmen and on an absolute equality with them under the orders of foremen. This at present is distasteful to the middle-class Indians who aspire to attain the same position by theoretical training which the British attain through practical and theoretical training combined. It is an axiom in one excellent educational system—the Swedish—that the hand educates the brain, and in point of fact I have found the trained Indian artisan to possess an intellect far more in accord with Western thought than the book-learned classes. These men cannot be handled by any but practical workmen as supervisors, and therefore the dream of technical education *per se*, supplying a class of efficient engineers, etc., of the higher class is a vain one. If some means could be found of inducing the middle classes, now exclusively literary, to undergo the necessary manual training, the problem of Indian industries would be solved. I have had much to do with Indians in three Presidencies, and I know that the matter is in them, if only means could be found to bring it out; for the higher classes, if they would only take the practical training would excel the present lower class workmen just as at home the youths of the better classes pass beyond the workmen of the artisan class, commencing at the same benches and the same manual work.

That, sir, is the true industrial problem of India and the solution lies in imbuing Indians of the better classes, hitherto accustomed to a literary career only, with a sense of the real "dignity of labour." No "technical colleges" will solve this problem.

—C. J. in "The Indian Agriculturist,"
March 1, 1912.

Bamboo for Paper Making. THERE is not 30 years' supply of wood for papermakers' pulp left in North Europe and America. The price of pulp is jumping. The demand for paper is increasing by leaps and bounds, and a famine in wood pulp from the world's northern forests is inevitable. Whole countries have been placed on the first stage of the dread road that ends in such deserts as those of Central Asia, by the short-sighted greed of the lumber interest. Our fear, however, of a universal famine in paper is now being dispelled. The news is the more welcome because it is coupled with the hope that the destruction of our woodland may also be stayed, and that wisdom may in time lead to re-afforesting. Bamboo forms an excellent material for the manufacture of paper and this is already being turned to commercial account. Mr. R. W. Sindall, a consulting chemist and wood pulp and paper expert, who, in 1904, made an inquiry into the possibility of making paper-pulp and paper in Burma, proved that from the bamboo an excellent pulp could be made and that it could be exported to England at a price that should prove exceedingly remunerative. A difficulty has been in the bleaching, but this has now been obviated. Treated by the ordinary bi-sulphate process and by a new method simply and inexpensively bleached, it yields, it is stated, an excellent pulp, felting readily, and producing a paper pliant, resistant, and opaque, of enduring colour, thicker than other paper of the same weight, and forming one of the very finest materials for writing and printing, and of exceptional value for engraving. In order that all these excellent qualities may be preserved in the paper, however, it is essential that no part of the preparatory treatment of the pulp is carried out away from the district where the bamboo grows. Mr. H. Vincent, an American expert, estimates that under intelligent administration of cheap tropical labour, the cost of a ton of bleached pulp should not exceed £6, and that it should be worth, at an extremely modest estimate, £10. Mr. Sindall calculated the cost of a ton of unbleached Burma pulp landed in London or Liverpool at £7 10s. Having regard to the quality of the pulp he thought that a much higher price would be secured for it in the London market, as ordinary wood pulp realised from £8 to £9 per ton. Roughly, therefore, it costs as much to put a ton of unbleached Burma pulp on the English market as it would cost by Mr. Vincent's scheme to produce a ton of bleached pulp at the factory in the Panama zone.

It would seem, then, that the planting of bamboos for paper-making is an undertaking which might well be started. It is

thought that if paper were supplied from the tropics, instead of from the present sources, it will involve a considerable re-adjustment of the pulp industry, and the solving of many questions, among which that of labour will not be the least. This is considered in some quarters to be an objection to the growing of bamboos. It is a mistake, however, so to regard it. If bamboo comes to the rescue, it will go far to save the forests, which, if bamboo or other material be not used, will become so thinned that there will be no industry to re-adjust. It will also bring down the price of paper.

It remains to be seen if the industry is one which might be undertaken in Ceylon. It certainly is. Many, all, one may say, of the low-country districts of Ceylon are eminently suitable for the growth of the bamboo, which can be cultivated like any garden crop. After being cut down, the grasses, or rods, grow up again in about two years. Ceylon has the climate for the growth of the product, the labour for its transformation into pulp, and the water necessary for its manufacture. Machinery can, of course, be provided. Mr. T. P. Masilamany, of Jaffna, in a recent article in the " Morning Leader " of this town, gave particulars of the cost of a plant, the expenses of working it, and of the estimated profits which he puts down at 24 per cent. per annum. The figures he gives have every appearance of reliability, and it would thus seem that still another may be added to the long list of tropical and Ceylon industries. If Ceylon does not wish again, as in the case of rubber, to remain behindhand she must hasten, for the idea is at present being vigorously pushed in Indo-China, by an Anglo-French Company, a representative of which passed through Colombo a short time ago. The work is being undertaken on a very big scale ; the very latest things in machinery have been provided and they are absolutely confident of producing very large quantities of paper within a very short time. The growth of bamboos for the production of paper is certainly worth the attention of Ceylon capitalists.

—" Tropical Agriculturist " : (Ceylon).
February, 1912.

What Might Have Been.

" If, twenty years ago, this University (Oxford) had said, from this time forward the elements of natural science shall take their place in Responsions side by side with the elements of mathematics and shall be equally obligatory, you would long ago have effected a revolution in school education."

—Dr. Percival.

Visits to Country Districts.

NORTH WESTERN DISTRICT.

The Assistant Director has visited the Experiment Station at Issorora in the North Western District and commenced the tapping experiments with the Para rubber trees that have reached a tappable size. These experiments have for the present been laid out in two series, with two groups in each series. The trees are being tapped on alternate days on the half-herring bone system and the latex is being coagulated with dilute (1 in 10) acetic acid. Notes made at the time the experiments were commenced show that the trees on the Station may be divided into at least four groups according to the structure, thickness, etc. of their barks. Records are being kept of the different trees, and it will be possible later to compare the yields of rubber given by different types of plants. The latex in some trees was found to be of a yellowish hue at first, but eventually turned to a whitish colour as tapping proceeded. In others the latex is a pure white from the commencement. The first latex obtained was of a thick consistency and coagulated readily in the cuts but after a few tappings it became thinner and ran readily into the cups. The rubber is for the present being turned into biscuit form and is well washed in cold rain water. It appears to be of good quality, and is of good strength, elasticity and resiliency. A careful record is also being kept of the times that rain or showers fall at the station in order that after a few years reliable information may be available for the district. The question of the time when rain falls in a district is of importance for rubber planters, and data on this point is required. Tappings of young plantation *Sapium Jenmani* are also being commenced. The latex of these trees did not run freely. It coagulated readily and consequently the rubber had to be collected as scrap. This rubber when carefully washed and dried appears to be of good quality. Several systems of tapping will be tried and the relative yields of the different methods will be obtained.

Extension work is being pushed along, and the planting of *Hevea brasiliensis* is taking place as rapidly as possible. The planting of the third ten acres of the extension over the creek should be completed during this year, and further trials are being made on the hill slopes in conjunction with balata, letterwood, and bastard letter-wood. Trials with various kinds of coffee are also being undertaken and it is possible that planting of the creole variety on the hill slopes will be started.

A visit was also made to the David Young Rubber Estates on the Aruka river, and the progress of the different kinds of rubber-producing trees was noted. The Para rubber trees were bearing quite a fair crop of seed pods, and with suitable weather conditions a number of seeds should be obtained from this property this year.

CHRISTIANBURG.

The Senior Agricultural Instructor has visited Christianburg and has inaugurated a series of trials on the older plots of Para rubber with various kinds of cover crops. It is hoped that these crops will keep down the weeds and hence enable us to reduce expenditure on weeding. It is also hoped the rubber will grow better under this system than under the former systems of cultivation when weeds were cut down three or four times a year.

WAKENAAM.

The Agricutural Superintendent and the Head Gardener visited Plantation Marionville, Wakenaam. They went through the cane cultivation and also inspected the Para rubber plants growing in the nurseries and in the fields.

BERBICE.

The Assistant Director has visited Plantations Providence and Creeklands in Berbice, and has inspected the rubber and lime cultivations on these properties.

The Agricultural Superintendent has visited New Amsterdam to investigate some lands that it was proposed to set aside for extension purposes for the Department. He was accompanied by the resident Agricultural Instructor, and the circumstances of drainage and irrigation were carefully considered.

F. A. S.

Teaching Children to Think for Themselves.

In teaching children to experiment, a teacher must exercise extraordinary self-restraint in withholding information: however slowly the argument may develop it *must be allowed* to develop solely on the basis of the facts established in the course of the inquiry, taking into account besides these only common knowledge. Teachers are not trained at present to work in such a spirit—but more's the pity, more's the shame!

—Prof. Armstrong in "Training in Scientific Method."

Agricultural Instructor's Reports.

BERBICE.

Mr. Instructor Augustus has visited farms and grants on the Lower Berbice River and has selected some sites for demonstration plots. These have been chosen in diseased cacao, coffee and plantain land on the grants of progressive farmers, and they will be dealt with from the purely practical point of view. It is hoped to commence work at an early date. The report from this district indicates that some of the farmers did a considerable amount of good drainage work in the dry weather and that the crops were progressing favourably with the advent of the favourable rains.

Mr. Augustus has also visited the school gardens attached to the different schools in the county of Berbice, and has assisted the teachers with their cultivations.

Visits have also been made to the West Coast of Berbice and quantities of selected pure-strain seed paddies have been distributed to rice-growers. Increased interest is being taken in the seed paddies distributed by the Board of Agriculture, and a fair number of farmers have undertaken to grow these paddies in competition with the varieties ordinarily cultivated.

Mr. Augustus has also visited several of the properties on which Para rubber has been and is being grown. He reports favourably on the general growth of the rubber plants, and states that they appear to be healthy and to have stood the drought satisfactorily except where they were planted on heavy unsuitable soil.

EAST COAST, DEMERARA.

Mr. Fitz Greeves has visited the village cultivations along the lower East Coast of Demerara and has been present at several meetings of farmers. The area under cane cultivation at Buxton and Friendship has been increased and the crops are in a good condition. The canes are short but appear to be healthy and vigorous. Opportunity was taken during the drought of having the sideline drainage trenches dug, and the drainage on the whole has been greatly improved. The provision crops appear to be generally satisfactory although considerable damage has been allowed to have been occasioned by caterpillar pests.

The cultivation at Golden Grove and Nabaclis does not show much improvement and the majority of the farms are only described

as "fair." Bud-rot disease of coconuts was noticed and steps have been taken to get the diseased trees cut down and destroyed. A disease of breadfruit is also common and farmers were strongly recommended to spray or syringe the young fruits with Bordeaux mixture (for a description of the disease see page 14 of this number of the *Journal*).

At Ann's Grove and Two Friends the sideline trenches have been dug out but the middle walk trench requires cleaning. The cultivations on the whole fair, but considerable improvement can take place on many of the farms. Some of the cultivations of cassava were quite promising but the plantain cultivations were not very satisfactory. Too little attention is paid to the proper selection of suckers for planting purposes and more cultivation should be practised if better results are to be obtained. A disease of breadfruit was also noticed and appeared to be common.

CO-OPERATION AT VICTORIA.

At Victoria the farms have improved considerably, and the cultivations are in good order. Tillage was not neglected during the long drought in this village and consequently the crops benefitted considerably when the rains commenced. A fair area of coconuts exists in this village and more are being planted : with but one or two exceptions, the trees are in good condition. A proposal to put the abandoned lands in this village under cultivation by co-operation amongst the farmers has been started, and a Co-operative Agricultural Society has been formed. Mr. Greeves was present at one of the meetings when the proposal was discussed and it is hoped that the villagers really intend to put some good work into the lands that are at present in ruinate.

The cultivations at Triumph and Beterverwagting are on the whole in satisfactory condition but in some instances the planting of the provision crops has been done too close. There seems to be a neglect of plantng permanent crops in this village and the rotation of provison crops requires attention. The coffee in this village has been badly neglected.

At Plaisance the cultivations are on the whole fair, but more attention could be given to proper tillage.

Throughout the whole of the East Coast of Demerara caterpillars have been very common and have occasioned considerable damage. The cassava crops have been defoliated by *Dilophonota ello* and the canes have been damaged by the grass caterpillar (*Remigia*

repanda). Efforts have been made to awaken the farmers from their lethargy, often with but .little success. These seem to find it very difficult to make the continuous effort necessary for the control of insect pests, and prefer to sit down and see their crops destroyed. Nor do they seem in some instances to have been at all encouraged by the officers of their Agricultural Societies in the fight against the caterpillars that this year became so very common with the advent of rains after the prolonged drought.

CANAL POLDER.

Visits were made to several estates in this district by the Agricultural Superintendent and Mr. Instructor Augustus. A large number of cacao trees died in this district during the drought and also many branches and twigs. In most cases the deaths occurred in trees that were badly affected with canker. Whereas in favourable years diseased trees manage to appear to be fairly vigorous, when unfavourable seasons occur the most badly diseased (and consequently the weakest) find it difficult to pull through. Efforts should be made in all old cacao cultivations to replace badly diseased stems by means of healthy, vigorous suckers and all cankered areas shoud be cut out as far as is practicable. Many of the estates in the Polder require more thorough tillage and better drainage. Advantage was taken of the drought to improve the drainage of many estates and several propose to adopt better tillage. Coffee did not suffer so badly in this district during the drought as did the cacao, and has made good progress since the rains commenced.

POMEROON.

Mr. Instructor Matthews reports that caterpillars have been very prevalent in the Pomeroon district. Cassava and rubber has been affected by *Dilphonota cllo*, sweet potato by *Protoparce cingulata*, the grass and corn by *Remigia repanda*. Some of the farmers have picked off quite a number of the pests with satisfactory results but others practically attempted nothing for their control. This district suffered severely from the drought and many of the provision crops were failures. The corn crop will be a poor one, for even with the rains considerable difficulty was experienced in establishing good fields. The permanent crops suffered, but are now commencing to recover. Coffee has a promising appearance. Rubber is looking very well and is making good progress. Coconuts on some grants look well, but on others some disease is to be noticed. A certain number of diseased trees have been cut down, and other owners are being urged to adopt similar precautions against the spread of disease.

The Experiment Station at Marlborough suffered from want of water in the drought and losses of plants took place. These have been replaced and every effort is being made to push these supplies along.

NORTH WESTERN DISTRICT.

Mr. Instructor Abraham reports that the extension work at the Experiment Station is being pushed along. The provision crops did not give very heavy yields and one crop of yams failed entirely. This loss of crops is attributed to the drought. The rubber stood the drought very well indeed and continued to make some growth. The younger fields are now beginning to show up, and their drainage is receiving attention. The Sections A. B. and C. which were recently re-cleared have been planted up with *Hevea brasiliensis* and Extension III. has been laid out and planted with provision crops, preparatory to being planted with coffee and rubber at the end of the year.

The provision crops in the district have progressed considerably since the drought broke and are now commencing to look well. The caterpillars of *Dilophonota ello* have caused some damage to cassava in the district and have been found on some rubber trees, but so far have not been very prevalent.

F. A. S.

An Early Opinion on Science in Education.

I am sorry to have occasion to observe that natural science is very little, if at all, the object of education in this country, in which many individuals have distinguished themselves so much by their application to it. And I would observe that, if we wish to lay a good foundation for a philosophical taste and philosophical pursuits, persons should be accustomed to the sight of experiments and processes in early life. They should more especially be early initiated in the theory and practice of investigation, by which many of the old discoveries may be made to be really their own—on which account they will be much more valued by them. And, in a great variety of articles, very young persons may be made so far acquainted with everything necessary to be previously known as to engage (which they will do with particular alacrity) in pursuits truly original.

—Priestley (the discoverer of oxygen gas) in "Preface to Collected Works," 1790.

Answers to Correspondents.

R. W., F. A. S., F. G., R. L. H., (Botanic Gardens and Experimental Fields); K. (Botanic Gardens); C. S. (Essequebo); S. (Wismar); W. H. M. (Pomeroon.)—The larvae you sent as damaging Cassava and Rubber (*H. brasiliensis*) are those of the Hawk Moth *Dilophonota ello* (Linn). It has appeared in enormous numbers during this month. (See article in this number of the *Journal.*)

R. L. H. (Botanic Gardens); W. H. M. (Pomeroon).—The larvae you sent down as feeding on the Wild Potato Vine (*Phomea fastigata*) are those of the Hawk Moth, *Protoparce cingulata* (Fabr.). It also feeds on the leaves of the cultivated sweet potato.

R. L. H. (Botanic Gardens).—The larvae and pupae you sent as feeding on the cultivated Grape Vine were those of *Anosia plexippus*, one of the commonest of our butterflies.

D. G. (Calcuni, Berbice).—No insects emerged from the mangoes you sent, but traces of attack were visible. The 'eggs' you sent were the puparia of males of the Mango Snow scale—*Diaspis* (*Aulacaspis*) *rosae*.

N. H. (Mahaicony).—The insects you sent as damaging the stems of young plants were mole crickets. They are exceedingly difficult insects to deal with. The best method in your case seems to be turning up the soil in the affected parts and destroying the crickets thus exposed.

New Colonal Co. (Georgetown).—The insects you sent as damaging rum casks were the ordinary shot hole borers *Xyleborus perforans*. The house where the casks are stored should be thoroughly cleaned.

F. A. S., R. W., R. L. H. (Botanic Gardens), C. S. (Georgetown).—The larvae you forwarded were those of the Hawk Moth, *Argeus labruscae*. The adult is green in colour with green and purple markings on the under wings.

R. L. H. (Botanic Gardens).—The larvae you sent down pupated and finally emerged. They have been determined as belonging to the *Hydrophilidae*—*Hydrophilus ater* (Fabr.). The Imperial Department of Agriculture for India has recently published a memoir dealing with the life histories of the family. (Memoirs of the Department of Agriculture in India. Ent. Series, Vol. 2., No. 9.)

W. H. M.—The dark green variety of coconut was a particularly interesting one and the yield per tree should be ascertained. We should be glad to receive other specimens.

Rubber.—The damage to your young plants is probably occasioned by rats, labba, and other rodents. In the East it is recommended that the young plants should be treated with a thin layer of tar to a height of 2-3 feet above the surface of the ground. Rodents, it is asserted, will not attack tarred stems. Only stems that are brown and hard should receive this treatment, as the young green stems are often injured by tar. This method has been tried on one or two estates in the colony, with satisfactory results.

L. F.—Woolly Pypol thrives in the colony. It is doing very well at the Botanic Gardens and is being tried as a cover crop at the Experiment Stations. It seems to produce here a vigorous cover crop, and may prove useful for that purpose.

F. C. and F. W. H.—Tonka Beans are, we believe, under cultivation in Trinidad. There are two plants at Onderneeming Experiment Station. One of these flowered when it was 7 years of age but did not set fruit. In Venezuela the seeds are spread to dry on large granite slabs and are then shipped to Cuidad Bolivar or to Trinidad for crystallization. In this process the seeds are steeped in strong rum for twenty-four hours, and are then taken out and spread out to dry. The seeds shrink in drying and present a wrinkled appearance when ready for final shipment.

G. and Others.—The yields of castor oil seeds vary according to land and cultivation. The average is 500-800 lbs. of clean seeds to the acre for moderately good cultivation, but with good cultivation on good land yields of 1,200-1,400 lbs. may be obtained. An extraction of 30 to 35% is obtained by the native methods and one of 42 to 43% when up-to-date machinery is employed.

S. P & Co.—The seeds have suffered from the prolonged dry weather. No disease appears to be present. The germination results of some of the Hevea seeds obtained recently at the Experimental Fields have not been very satisfactory owing to the drought.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods setting out the number of pupils who attended the Model Gardens of the colony from April 1, 1907. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to March 31; April 1 to June 30; July 1 to September 30; and October 1 to December 31. The totals only during 1907 and 1908 are given; the records since then are in detail.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1907.										
2nd to 4th	1,261	928	994	835	556	...	...	...	...	4,574
1908.										
1st to 4th	5,447	3,386	1,477	887	1,053	160	...	...	...	12,410
1909.										
First	1,638	710	338	463	370	302	...	...	...	3,821
Second	1,707	677	329	142	288	446	...	...	...	3,589
Third	¶1,252	742	433	436	172	378	223‖	...	...	4,636
Fourth	1,876	536	438	236	362	771	439	...	...	4,858
1910.										
First	1,282	769	287	370	259	489	465	..	...	3,921
Second	1,311	558	787	894	303	455	519	403§	...	5,240
Third	¶1,234	526	910	748	294	510	498	537	...	5,257
Fourth	1,209	444	1,285	336	295	493	502	592	...	5,156
1911.										
First	1,086	360	1,042	838	312	514	414	572	577	5,695
Second	1,263	326	713	816	286	292	536	591	688	5,511
Third	¶1,093	385	910	627	361	297	543	441	639	5,296
Fourth	1,687	448	935	588	447	406	737	957	540	6,745
1912.										
First	1,127	379	1,374	1,034	425	207	573	359	423	5,901
Second	1,385	359	1,096	900	484	553	730	461	413	6.381

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

¶ Schools in vacation during August.

‖ Instruction commenced in July.
§ Instruction commenced in April.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to June 30. The corresponding figures for the three previous years are added for convenience of comparison :—

Product.	1909	1910	1911	1912.
	Jan. 1 to June 30.			
Sugar, tons ...	41,130	30,262	30,368	22,337
Rum, gallons ...	1,039,030	884,000	671,468	1,275,992
Molasses, casks ...	152	454	437	906
Cattle-food, tons ..	4,040	3,382	2,461	2,417
Cacao, cwts. ...	370	253	159	102
Citrate of Lime, cwts.	27·6	57·3	25·4	0·5
Coconuts, thousands	218	455	472	875
Copra, cwts. ...	290	141	746	817
Coffee, cwts. ...	1,120	978	685	1,147
Cotton, lbs. ...	...	.	...	...
Fruit, brls. and crates	...	...	..	...
Ground Provisions, value	$134 04	$414 32	..	...
Kola-nuts, cwts. ...	38·2	9·6	...	...
Rice, tons ...	2,363	3,588	1,446	2,068
Rice-meal, tons ...	665	811	491	1,140
Starch, cwts. ...	..	4	..	...
Cattle, head ...	492	584	472	288
Hides, No. ...	1,814	2,881	2,201	1,947
Pigs, No. ...	275	444	509	629
Poultry, value... ...	$40 48	$ 62 76	...	..
Sheep, head ...	8	69	21	37
Balata, cwts. ...	1,968	2,041	1,670	317
Charcoal, bags ...	40,159	39,028	38,130	37,825
Firewood, Wallaba, etc., tons ...	4,185	5,267	5,893	5,290
Gums, lbs. ...	6,308	759	2,518	2,425
Lumber, feet ...	71,072	106,603	243,085	99,550
Railway Sleepers, No.	1,500	500	2,020	3,876
Rubber, cwts. ...	19·7	7·2	17 3	1·3
Shingles, thousands	740	981	1,473	819
Timber, cubic feet	187,161	181,813	127,706	142,359

Selected Contents of Periodicals.

Manioc.

Le Cacao Africain.

—L'Agriculture pratique des Pays chauds, Jan.—May, 1912.

The Value of Birds to Man.

— Nature, Dec., 1911.

Bee-keeping in Cuba.

—Gleanings in Bee Culture, Dec., 1911.

Courses in Agricultural Colleges.

Co-operative Company Insurance Societies in 1910.

—Journal of the Board of Agriculture (England), May, 1912.

A German View of New Zealand.

Pension Schemes for Civil Servants.

—The Colonial Office Journal, April, 1912.

Vitality of Rubber Seeds.

—Agricultural Bulletin of The S. &. F. Malay States, Feb., 1912.

Rural Education in our Village Schools.

On the Vitality of Farm Seeds.

Annual Report of the Botanist.

Annual Report of the Zoologist.

—The Journal of the Royal Agricultural Society of England, Vol. LXXII. (1911).

Underground Waters for Farm Use.

—U.S. Geological Survey ; Water Supply Paper 225.

Trinidad and its Rubber.

—The India-rubber World : July 1, 1912.

The Assimilation of Nitrogen by Rice.

—Hawaii Agricultural Experimental Stations, Bulletin No. 24.

JOURNAL
OF THE
BOARD OF AGRICULTURE
OF
BRITISH GUIANA.

VOL. VI. OCTOBER, 1912. No. 2.

Local Development in Agricultural Research.

In the report on the Agricultural Conference at Trinidad submitted to the Combined Court by the Chairman of the Board of Agriculture occurs a small paragraph (No. 34) referring to a discussion which arose on the trip home to Demerara between proprietors of sugar estates in British Guiana, representatives of other proprietors, and the Director of Science and Agriculture as to the great desirability of the extending the investigations into sugar-cane at present carried on in the colony. We are in a position to state that steps have since been taken by the proprietors, in consultation with the Director and Assistant Director of Agriculture, to carry out the extension then unanimously agreed upon and to formulate a scheme which will not entail any call upon the revenues of the colony. Several meetings of proprietors have been held, and it is satisfactory to find that the scheme as at present designed has practically the unanimous support of the sugar interest in British Guiana; it will affect an acreage of about 65,000 under sugar-cane out of 66,800. The most important aim of the scheme is to unite the agriculturists of this colony in co-operative work and to utilize for all taking part in it the many centres of agricultural investigation which are in existence on the various estates but which at present have not the advantage of a centralized organization. It is hoped in this way to abolish unnecessary duplication of work and to facilitate collation of results to an extent which had not hitherto been found possible. In short, it is the first movement towards co-operative agricultural work on a great scale which has been undertaken in this colony with any prospect of success.

The objects of the extension contemplated are :—

(*a.*) The investigation and control of insect and fungus attacks on the sugar-cane and researches into the causes and prevention of the defective nutrition and the physiological derangements in the plant which at present appear to affect adversely its constitution and to reduce materially its yields in the field.

(*b.*) The production of new varieties of sugar-cane by controlled parentage and subsequent selection, with enquiries into their powers of resistance to physiological derangements, fungoid and insect attacks, the permanency of their desirable characteristics, and their suitability and adaptability to the various types of soils and the differing meteorological conditions existent in British Guiana.

(*c.*) Enquiries conducted by scientifically controlled methods into the manurial requirements of new varieties of sugar-cane upon the various types of soil found on the sugar plantations of the colony. These enquiries would be more especially directed towards ascertaining the different demands for nitrogen by the various new varieties under plantation conditions. Similar investigations would be carried on with regard to newly-introduced sources of nitrogen, potash, phosphates, etc., in the hope of thereby obviating or largely reducing chances of loss by their unskilled or unrestricted use.

(*d.*) Enquiries into methods of cultivation, the conservation and improvement of the fertility of soils and problems relative thereto.

It is proposed to investigate these questions on a large scale and under estate conditions, but it is also intended to establish nurseries for selected sugar-canes of approved parentage and purity of strain for distribution. Although tnvestigation into the sugar-cane is the primary object of the scheme it is not intended to restrict it to this. Of late years the proprietors of the larger sugar estates have developed a tendency to broaden their cultivation and to extend it from sugar-cane over coconuts, Para rubber and rice as well as to a less extent over limes, coffee and fruit. The example thus set will doubtless have a most beneficial effect on the small proprietor and peasant farmer, who will be guided in his own work by the results obtained on the large estates.

The general control, the selection of the lines of enquiry to be followed and the necessary financial arrangements are to be vested in a committee of proprietors and representatives of proprietors of sugar plantations in British Guiana, and of this committee the Director and Assistant Director of the Department of Science and Agriculture are to be *ex officio* members. The Director has unanimously been elected Chairman of the Committee, and to him are to be entrusted the administration and scientific direction of the various enquiries and researches. The experiments carried on at the Botanic Gardens and elsewhere are to be continued on the present lines, and the Government is asked to assist the new scheme by freely allowing access to the facilities for research established at the Government Laboratory, Experimental Fields and the Biological Laboratory of the Board of Agriculture. At the inception of the scheme a central experimental station will be started on soil of a lighter nature than that of the Experimental Fields. This station will probably have an area of about 50 acres and will be situated near Georgetown. Experiments will be conducted on other plantations for the study of special problems which may arise or be existent thereon. It is proposed that the special staff required for the scheme shall include a superintendent, a mycologist, a chemist, an entomologist for field work, and the necessary clerk. The total expenses are estimated at $12,000 to $15,000 per annum. So important and far-reaching a scheme cannot but have an immense influence upon the prosperity of the colony which is so intimately bound up with that of its staple product; and it is with the greatest satisfaction that we lay the details before our readers.

The Examination of the Future.

The Inspector of the future will be satisfied with evidence that you have taught regularly and rationally during the year and will not exact proof of a certain stage of mental development having been attained during the year any more than he requires a particular stage of physical development to be reached. The essence of your method must be that practically everything is done by the scholars themselves.

—Prof. Armstrong in "Science Teaching in Schools in Agricultural Districts."

Sugar-Cane Experiments in Antigua and St. Kitts 1910-11.

WE have just to hand a very interesting report by Mr. H. A. Tempany, B.Sc., F.I.C., F.C.S., Superintendent of Agriculture for the Leeward Islands, on the experiments conducted with varieties of sugar-cane and different manures in Antigua and St. Kitts in the season 1910–11. The form which the report takes is a marked advance on earlier practice, and the omission of many tables of figures and the introduction of the graphic method of expressing results make the report very readable and lucid. The conditions in the Leeward Islands are so very different from those in British Guiana that considerable interest attaches to the behaviour of Demerara seedlings on the areas dealt with by Mr. Tempany and to the contrast which his manurial results afford to those obtained by similar experiments in this colony.

Part I. of the report deals with experiments with varieties of sugar-cane ; and in it the author alludes to the large number of cane varieties lately introduced into cultivation in his district and to their rapid adoption by the estates. This, he says, is a striking testimony to the value of the experiments, and the personal experience of planters in connection with them forms an adjunct of the highest value. Amongst the recent introductions in Antigua, B4596 seems to have given the most uniformly satisfactory results. In appearance the cane is erect, stout, with long inter-nodes of a greenish yellow colour, flat and pointed eyes and a broad shallow channel. It is more distinguished for the high tonnage of cane yielded by it than for the saccharine richness of its juice, though in this latter respect it is fairly satisfactory. It is a favourite with planters, and the area cultivated under it is extending considerably. B1528 is another newly introduced cane, which is, with lapse of time, proving its suitability to the conditions attaining in Antigua. In appearance it is fairly stout and inclined to trail ; the stem is of a rich purple colour, the eye buds flat and pointed ; and it has a broad, well pronounced channel. As a ratoon it has consistently occupied a good position. B1752, formerly regarded as a cane of considerable promise, is now showing signs of falling off especially in dry areas. D1111 after a bad start, seems to have found its feet and is rising steadily in the tables. It supplies an excellent instance of that adaptability

to new conditions which Mr. Tempany continually refers to as a feature of certain seedling canes. White Transparent still continues to occupy the position of the standard cane in Antigua, but it appears—especially on the heavier lands—to be showing an increased susceptibility to the root disease *Marasmius sacchari* which is one of the chief factors limiting the success of sugar-cane in the Leeward Islands. D109 and D625—the latter described as an exceedingly handsome and attractive cane—are also suspected of liability to fungus disease, and this handicaps their popularity among the planters. On the whole, the Barbados seedlings seem to have given satisfactory results; the Demerara canes less so. In Demerara conditions the Barbados varieties frequently deteriorate into grass-like growths with numerous very small canes. Mr. Tempany intends to lay out special experiments in the forthcoming season to test the opinion expressed that the planting of Demerara canes in the Leeward Islands is not close enough. They are, he says, well developed canes in themselves, but few to the stool. The Demerara practice is to plant in rows either 5 or 6 feet apart the tops being 15 inches to 2 feet apart in the row. This mode of cultivation is determined by the very heavy nature of the soil, the heavy rainfall (up to 120 ins. per annum on some estates) and the exuberant growth of grass and weeds.

Part II. deals with manurial experiments with sugar-cane; and as a result of 10 years continuous experiment Mr. Tempany finds that the limiting factor to the manurial requirements of cane in the Leeward Islands is the water supply available for growth. The best results with ratoon canes which received no artificial manure as plant canes have been obtained with nitrate of soda and sulphate of ammonia applied in single doses and without other manurial constituent at the rate of 40 lbs. and 60 lbs. of nitrogen per acre. Dividing the dose reduces the yield, which is not increased by phosphate and potash. Nitrate of soda has given better results than sulphate of ammonia. A two years trial with nitrolim (calcium cyanamide) tends to show that that manure does not affect the yield. Experiments with nitrate of lime alone extending over the same period have given results about equal to that of sulphate of ammonia but inferior to nitrate of soda. The opinion is expressed that its action is too slow to be of value to ratoon canes. Molasses, as in Demerara, seems to be of no value as a manure for cane, nor does liming (judging from the result of two years experience in St. Kitts) appear to increase the yield. Experiments

are in progress in the treatment of soil with disinfectants after the methods of Russell and Hutchinson.

We might perhaps suggest to Mr. Tempany that D1135 and D1451 be tried in his district: they are doing very well in Queensland and Hawaii; and that he could materially add to the interest of his tables if he indicated in them the ranges of the "probable errors" incidental to them. For instance if he adopted the yield of the White Transparent variety as 100 on each plantation, he could calculate those of other varieties relative to a hundred, and then from the relations indicated (using Peter's approximation formula) calculate the probable error of a single trial from the mean results and the probable error of the mean of all trials. Similarly with the manurial experiments, using the yields of duplicate or triplicate non-manured controlled plots as a hundred. However this may be, we congratulate Mr. Tempany on a most excellent and well arranged report.

The Effect of Examinations.

I have no hesitation in saying that at the present day the so-called science taught in most schools, especially that which is demanded by examiners, is not only worthless but positively detrimental. All who are acquainted with the facts know this to be the case, and if we ask ourselves the simple question whether what is done tends to develop the wits, to develop the power of self-help, we must all admit the very opposite to be the case.

Schools, in fact, are engaged in fashioning our youth to require leaning-posts, not in training them to act on their own account; examinations have made self-help impossible. No employer, go where you will, is satisfied with the product the schools turn out.

—Prof. Armstrong in "An Appeal to Headmasters."

The Necessity for Science in Education.

Literary and mathematical studies are not a sufficient preparation in the great majority of cases for the work of the world—they develop introspective habits too exclusively.

—Prof. H. E. Armstrong in "The Teaching of Scientific Method."

Note.

Bulletin of the Imperial Institute.

FIRST issued in 1903, the Bulletin of the Imperial Institute now appears in enlarged form and from a new publisher. This change has been necessitated by the greatly increased demand for the magazine. It is still a quarterly and its contents are still of the same high scientific and practical value——reports on investigations conducted in the scientific and technical department of the Imperial Institute; articles and notes dealing with mineral and vegetable economic products, and a quarterly summary of information on the recent progress of Agriculture and the development of natural resources. The issue which lies before us—which is No. 2 of the new series—contains Part II of a most valuable article on the "Coconut and its Commercial Uses"—a topic of the most lively interest at the present moment—and articles on the Tobacco industry of Ceylon; Some new Gutta-yielding Plants from the Gold Coast; *Ficus elastica* rubber from Southern Nigeria; "Balata" rubber (*Ficus Vogelii*) from Southern Nigeria; The Rubber of *Cryptostegia grandiflora*; Silk from India; Cotton and Sisal hemp from Papua (British New Guinea); Fibres from India; Utilisation of *Cæsalpinia digyna*; Oil seeds of *Telfairia pedata*; Lophira oil-seeds from West Africa; Oils and oil-seeds from Hong-Kong; West African cocoa; The Cultivation of cigar tobacco, with special reference to Java; Shea nuts and Shea butter; Rubber tapping experiments in Southern Nigeria; Economic developments in the Belgian Congo; West Indian satinwood; Oil of "Nephal Camphor wood"; Citronella grass; *Mesembrianthemum Mahoni* roots from the Transvaal; Rubber Exhibition in Java; Cultivation of fibres in Java; "Root-cotton"; Perilia seed and oil——making up (everyone must admit) a comprehensive and useful table of contents. For information as to the subscription and other details our readers are referred to Mr. John Murray, the publisher 50a, Albemarle Street, London, W.

Science for the Clergy.

"I sometimes dream of a day when it will be considered necessary that every candidate for ordination should be required to have passed creditably in at least one branch of physical science, if it be only to teach him the method of sound scientific thought.

—Charles Kingsley.

Science as a School Subject in British Guiana.

By the Editor.

I.

THE place of Science in the curriculum of the secondary school is nowadays too well established to need any apology, but the great changes which are taking place in the method of teaching Science, in the conception of the object of teaching it and of its very *raison d'être* as a school subject may serve as some excuse for discussing it in this place; more particula ly as it seems possible that in the peculiar circumstances of an undeveloped tropical country like British Guiana Science as a school subject may be found to have a somewhat different application as a training for the mind of the average boy than in more highly organised centres of civilization. By "Science" we understand the term in its widest sense.

FARADAY AND THE LECTURE METHOD.

Michael Faraday—who was in every way a great man—must, we suppose, be credited with the introduction of Science into the curricula of English schools. When examined before the Public School Commissioners at a period which ante-dated the Victorian era by but a few years, he said: "That the natural knowledge which had been given to the world, in such abundance during the last fifty years, I may say, should remain untouched, and that no sufficient attempt should be made to convey it to the young mind, growing up and obtaining its first views of these things, is to me a matter so strange that I find it difficult to understand. Though I think I see the opposition breaking away, it is yet a very hard one to be overcome. That it ought to be overcome I have not the least doubt in the world." To-day it may be said that the opposition alluded to by Faraday has been at last completely overcome; but the same cannot be said of the difficulties which have surrounded from the begininng the teaching of Science, the appreciation of its importance, and the realization of its true rôle in the school. Curiously enough, the origin of most of these difficulties may be ascribed to Faraday himself. The lecture method which was fashionable in Faraday's time, which had been, indeed, the means of introducing him to Science and

which he developed to a pitch of perfection never surpassed since, naturally led to the introduction of that method as the standard one in schools. It had many obvious advantages from the point of view of the conservative school Principal who had to advise a still more conservative and (as always) economical Board of Governors: it was simple in its working, was calculated to impart information in an easy and interesting way, and by conserving the tradition that schoolboys while in class should be subject to the discipline of immobility, it satisfied the pedagogic conscience. No visitor to the school of the period during working hours ran the risk of being shocked at the sight of boys "idling" under the pretence of "doing experiments" in a workshop-like laboratory. So the lecture method, supplemented by the printed text-book, became the standard method of teaching in English schools, and scientific advisers had perforce to accept it.

THE INTRODUCTION OF THE LABORATORY.

At first the tendency was towards physics as a scientific subject and to saddle the mathematical master with the responsibility of the science teaching; but with the development of chemistry and the rising demand for analysts, a course of test-tube instruction was interpolated, bringing with it the necessity for an expensively equipped laboratory. The lecture method and the text-book were supplemented by a practical course, which had no necessary connection with them, and of which the most practical aspect was that it qualified the boys for positions as assistants in analytical laboratories However, the establishment of a laboratory of any kind was a wise and welcome development which marked an immense step in the right direction and was one great victory won by Science after years of struggle. How long-continued and strenuous that struggle was against the inertia of scholastic opinion and the dead weight of literary influence will be remembered by many living to-day. To regard Science as revolutionary and subversive of discipline was the mildest opinion held regarding it in most quarters. It must be remembered that the masters to whom was entrusted the carrying out of the new ideas were almost to a man of the old school with fixed literary and mathematical ideas of teaching, and it was impossible for them to cut themselves adrift from their training and, by introducing new methods, to take full advantage of the resources placed at their disposal; and it is no blame to them that, as a class they

failed to realise fully the true scope and meaning of the revolution which had indeed begun. It is probable that many of the same class do not realise it even now, although within the last twenty years Science may be said to have entered at last into her kingdom.

THE GERMAN SCHOOL.

But while Science teaching was following a stagnant and unprofitable course in England, a generation arose which cut themselves adrift from the Old Country They saw she had deserted the ways of her true pioneers Boyle, Priestley, Dalton, Graham, Cavendish, and James Watt, and had become the mere mouthpiece of the German school of research—of which Liebig was the impersonation. As Kolbe said "Liebig was not a teacher in the ordinary sense of the word. Scientifically productive himself in an unusual degree and rich in chemical ideas, he imparted the latter to his more advanced pupils to be put by them to experimental proof; he thus brought his pupils gradually to think for themselves besides showing and explaining to them the *methods by which chemical problems might be solved experimentally.*" This original and illuminating conception of the true function of the Science teacher, established by Liebig, was faithfully carried out by his legion of pupils; and to such men as A. W. Hofmann and Williamson, and to Bunsen and his Heidelburg school, may be ascribed the introduction of the German methods to English students. How many of the present generation of Science teachers caught the divine afflatus on the banks of the Neckar it would be impossible to say; but the modern ideas and modern methods which are being pursued with such energy at the present day, and are turning out such useful products, certainly owe their inspiration to those who sat at the feet of "Papa Bunsen" and his colleagues. Those teachers have even improved upon their masters; for they are pushing the heuristic method in the schools, while the Germans still confine it to the Universities.

CRICKET AS AN ANALOGY.

The theory that Science should be taught by the experimental or research method is still perhaps so new to many that it may be worthy of a little extended consideration. Chemistry, for instance, is an experimental science: in its early stages, at least, as experimental as cricket, to use an analogy which may not

be quite perfect but is nevertheless instructive. Cricket, it may be urged, is not a science; but cricket could easily be developed on scientific lines. It would not be difficult to elaborate a syllabus which would include the principle of the "off-break," the mechanism of the "googly," the ballistics of the catch to cover point, the physiology of "form," the pyschology of "funk," and the sociology of captaincy; a syllabus which would draw upon many abstruse and recondite but recognised branches of Science; so that our analogy has at least some justification: and we shall find that it does illustrate in a very excellent way many of the points that arise when we come to consider the true principles of Science teaching. Take one of the earliest difficulties which arise—that of nomenclature. Naturally enough, the common substances which youngsters have to deal with when they begin the study of Chemistry have many names, which have arisen naturally and for good reason and are immensely interesting from a historical point of view. Chalk, they learn, is also called "calcium carbonate," caustic soda is "sodium hydrate" and "sodium hydroxide," while the blessed word "lime" may mean "quicklime" (which is calcium oxide) or slaked lime (which is calcium hydrate) or even Barbados lime (carbonate of lime), besides its botanical meanings—the "lime" of the tropics is quite a different thing to the "lime" of London or Berlin—and its application as a shortened form of "bird-lime." Any teacher who tries to lecture the Lower Forms of a school in the proper use of these terms must realise at once that something is wrong with the method. And when he becomes aware that some bright-eyed ornament of the Lower Second, who for the life of him can never distinguish rightly between "caustic soda" and "washing soda," "lime water" and "soft water," knows exactly where "short slip" stands in the field and his relation to "third man" and "cover point," and has a vivid mental picture of what is meant by a "no ball" or a "Ranjitsinji glide," he must recognise that one is the result of a living experience, the other a mere effort of memory; and he will regret, if he is honest, that Chemistry is not taught as experimentally as cricket. If he ponder the matter a little further he may wonder if the bright-eyed ornament aforesaid would have acquired his technical knowledge of the game quite so rapidly and accurately if he had sat with a row of friends on a bench and watched a demonstration lecture by his master, and whether the school XI which inflicted so

decisive a defeat on the visiting M.C.C. team would have done quite so well, if they had been allowed to commence "practical work" only on reaching the dignity of the Lower Fourth. As to the rules of the game and the finer points in theory he will recall that the Captain of the School Eleven discussed that knotty point which arose in umpiring with intelligence and restraint and a grasp that would have won an approving nod from Bob Thoms himself; illustrating his remarks too, with examples gathered from his experience and knowledge of the literature of the game: and the longing teacher wonders how many scholarships and distinctions he could win if his boys were allowed to commence Science in the same way. He vows, too—having some originality in him—that if enthusiasm can do anything he will make his subject as interesting as evidently the boys find their games to be.

THE HEURISTIC METHOD AND ITS AIMS.

The principle, then, that Science teaching must at first be purely experimental, is fundamental. It would be unreasonable to expect beginners to find out for themselves that the genitive of *mensa* is *mensae* or that *opus* is neuter; such facts must be taught dogmatically, and the Latin Primer is rightly devised for that purpose; but *it is possible* for a boy to find out for himself that caustic soda has a soapy feel, turns red litmus blue and can neutralize an acid, that carbon dioxide gas exists in the air and that oxygen is necessary to combustion in the ordinary sense; and in finding these things out for himself the youngster becomes aware of a power of which he was not conscious before. It is true that he could acquire the information at short order from a text-book, but in that case it would be mere information and not experience. To refer to our cricket analogy again there is all the difference in the world between reading in Ranjitsinji's Book of Cricket that a half-volley properly timed can be hit out of the ground for six—and doing it. It follows that Science if properly taught from the beginning develops ingenuity, resourcefulness, power of observation and a sense of self-reliance which literary studies, touching as they do an entirely different side of a boy's brain, are quite unable to bestow. In this lies the real justification of Science as a school subject and the secret of its immense value. To what

extent this is realised in England and on what lines Science teaching is developing in the Old Country, the following extract taken from an account by Mr. A. Vassall, M.A., F.Z.S., Senior Science Master of Harrow School, will show.*

THE METHOD AT HARROW SCHOOL.

"Experimental work bearing on whatever problem may be under investigation is done throughout by the boy himself and this is accompanied by occasional demonstration, information giving, summarising and heuristic lecturettes. The practical work is taken in small divisions which make a form of heuristic seminar possible. The boys begin with simple Natural History and the work of great biologists such as Darwin, Pasteur, Lister. The matter is not taken as a "subject" but simple chemical and physical phenomena necessary to the issue are considered; thus the presence of an atmosphere, the nature of oxidation, respiration and combustion are investigated experimentally as they occur. It is neither chemistry nor physics nor biology but all these "subjects" are drawn upon as necessary. The boys use simple microscopes as well as barometer tubes, air pumps and test-tubes, in the same course; they are growing moulds or infusions of *B. subtilis* one week and investigating the properties of oxygen the week after. The net result is some knowledge of a variety of subjects ranging from malaria and phagocytosis to vaccination and sterilisation, of a certain amount of hygiene and of some simple chemical and physical ideas.

"The next course is rather more definitely chemical in its nature Primarily it is based on the complete chemical investigation of some common substance, *e.g.* chalk, a candle, etc., by the boys themselves. The method is to proceed from the known to the unknown, and it is during this course that a scientific attitude is more definitely fostered. But again physical, chemical and biological properties are taken together as they call for attention and not separated into water-tight compartments. Real experiments in connexion with such daily life experiences as breathing, burning and decay, soils, disease, etc., can be as truly educational as crystallisation and fractional distillation.

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* *Science Progress* No. 24: April, 1912.

"The boys then pass on to more definitely physical work, *e.g.*, the electric installation of a house, using not toys but real commercial instruments—ammeters, voltmetres, motors, dynamos. They continue at this type of work till promoted beyond the reach of science or till they begin its formal pursuit, there being in addition to the above electrical course others on practical applications of the laws of heat and light, mechanics and sources of power, as well as other electrical courses including the making and use of telegraphs, telephones, electric bells, induction coils and wireless telegraphic apparatus.

"In 120 hours a boy can get a good deal more scientific information and rather more scientific training than is possible in the like time for his examination-ridden brother of similar capacity. A boy so trained will probably be ploughed in most conventional science examinations for boys of his age. But the writer firmly believes that he will keep his mental plasticity and his interest in scientific subjects and respond to his environment more intelligently than do many average boys differently trained."

SCIENCE AND THE EMPIRE.

The object of this training is well set forth by the same author; and it is remarkable to note the idea of Imperial development which lies at the root of the scheme. Here in British Guiana we are on the borders of the Empire and have the problem of development at our doors.

"Work for the average boy, instead of depending on his reasoning power and stimulating his mental self-reliance, is reduced to mere memorizing. Consequently there is a loss of plasticity and a lack of resourcefulness which are highly detrimental to him in earning his own living. Now that only a small percentage achieve administrative posts and the professions are over-crowded, an increasing number of average boys seek a livelihood as producers in the Empire either at home or Overseas. There is a useful place for every citizen of adequate moral strength Overseas and it is an Imperial obligation upon us to make them as useful there as possible.

"But plasticity, resourcefulness and self-reliance are exactly the necessary attributes. Hence it becomes more and more important that science masters by their methods should seek to strengthen and not thwart these characteristics as far as possible. Especially since it is obvious that for the successful

development of the resources of the Empire these boys need as far as we can give it to them a knowledge of the phenomena of their environment and the laws controlling them."

THE NEED OF SCIENCE IN BRITISH GUIANA.

If in a small settled country like England, Science is shown to have so great an influence in developing the manly side of a boy's character, should not that influence be taken greater advantage of in an undeveloped colony like British Guiana where at any moment a man may find himself face to face with Nature and thrown entirely on his own resources? And does not the fact that this point, though perhaps realised, has certainly not been fully utilised and developed account for a good deal of the lack of enterprise and the helpless herding together of the inhabitants of British Guiana? The average creole has never been taught to understand Nature, to know her laws, to utilize her forces, to save himself when opposed to her, and to impose his will upon her. He has no power of trained observation; he is consciously helpless when in difficulties. Bush life, when it does not frighten him, bores him to extinction; all he longs for is to get back to town or his game of bridge. Even those who spend their lives in the bush learn little or nothing; balata-bleeders are proverbially bad bushmen; they have not even the instincts of the aboriginal Indians in this respect. How can one hope to make pioneers of people with such a training, and how can the country be developed by such aid? The few brilliant exceptions merely prove the rule. Their pluck and enterprise are patent, and they have learned by experience—but at what a cost? Experience has proved fatal to many; the survivors, racked with fever or broken by hardship, are with us still to deter others. Their courage has been that of the untrained recruit, of Fuzzy-wuzzy attacking a British square. Had they but had a proper education, a preliminary drilling, some knowledge of that "variety of subjects ranging from malaria to vaccination and sterilization, of a certain amount of hygiene and of some simple chemical and physical idea" alluded to by Mr. Vassall, how much might have been saved them! If they had had a grounding in Natural History, how much richer in valuable information the Colony might now be! If youth but knew!

THE PRACTICAL EFFECT.

It would perhaps be too much to maintain that if Science were universally taught on proper lines in British Guiana

schools such a state of things as exists at present would be entirely eliminated. The love of Nature which precedes understanding is undoubtedly entirely absent in some cases, and the ignorance which is the mother of superstition is, we fear, in many instances a true racial characteristic; but that a genuine change would ensue we have not the slightest doubt. More, we maintain that it is the only way by which any radical improvement can arise and the present state of things be altered; and that if the present inhabitants of British Guiana fail to take advantage of modern ideas and modern methods they must speedily give way to that more adaptable and scientifically trained race which will inevitably supplant them. The developing of a country cannot be done by people clothed in a few pitiful literary rags and vulnerable at every point to Nature's weapons; Science alone can train men in defence against those weapons and fit them with that armour of resource which they need for the battle before them.

THE SPIRIT NEEDED.

That this should be accomplished it is not necessary that every one should be a scientist in the expert sense. Of the huge crowds which watch first-class cricket and Test Matches in England and Australia it is certain that a very small percentage indeed are first-class or even skilled cricketers, but the vast majority have played the game in their youth, understand the points of the play, and are imbued with the spirit of the sport. To a foreign spectator of the annual army manœuvres in Germany nothing is more striking than the intelligence with which the peasants follow all the details of the fight and the interest which the townspeople show in the troops and their welfare. Yet the thing is easy to understand: every man of them has had military training and is a soldier at heart. And so we argue that a sound and universal scientific training applied intelligently in British Guiana would spread abroad a new spirit, a spirit of enterprise, resourcefulness and independence in the true sense of the word. When British Guiana realises that the man without the fundamentals of an education in Science is only half-educated, and that not on his better and more profitable half, and that schools in which no form of real scientific training is given are not doing more than half their duty to the rising generation, a new era will have dawned for the country.

The Principles of Paddy Manuring.

By W. H. Harrison, Agricultural Chemist, Madras.

II.

HAVING now briefly summarized the conditions peculiar to paddy cultivation, and their effect on the question of manuring that crop, it becomes necessary to review the manures available in Southern India for this purpose and to discuss briefly their utility. For this purpose, the manures may be classed as follows :—

1. *Bulky Organic Manures.*—This class includes most of the popular manures for paddy, *e g.*, green manures, poonacs,* farmyard manures, fish manures. etc., and all of them are characterised by the large proportion of organic matter they contain and, as decomposition must take place before either humus is formed or the manurial ingredients become available as plant food, it is necessary to apply them some time before transplanting. The rate of decomposition of these manures is, however, very rapid under the conditions most obtaining under paddy cultivation and within less than one month it has proceeded far enough to be of benefit to the young plants and consequently there is usually no necessity to apply these manures more than one month previous to the time of transplanting. On the other hand, if applied only very shortly before transplanting, the manure is not sufficiently decomposed to be of much value to the plants, and, in addition, actual harm may occur owing to the products of decomposition seriously affecting the growth of the crop.

GREEN MANURE.

Wherever the local conditions render it possible to grow a crop previous to a paddy crop, manuring by means of a green manure crop may be carried out. Such crops as *Sesbania aculeata* ("daincha"), *Crotalaria juncea* (sunn-hemp), *Tephrosia purpurea* (wild indigo), *Phaseolus mungo* (green gram), etc., through the agency of peculiar bacteria which live on their roots possess the power of assimilating the free nitrogen of the atmosphere and storing it up in their tissues. On ploughing

* The refuse copra after the extraction of the coconut oil.

these crops into the soil, decomposition takes place and the nitrogen they have absorbed becomes available for the next crop. In other words, through their use, the cultivator has the power of obtaining the usually expensive nitrogen at a very low cost and consequently green-manuring must not be despised. The nitrogen supplied to a crop by means of poonacs costs from 8 to 8½ annas† per lb., that supplied by means of artificial manures costs about As. 10 per lb., whereas the nitrogen supplied by a green-manure crop is obtained merely at the cost of ordinary cultivation charges and may be put down as a maximum of one anna per lb., and, usually, the actual figure is much less than this.

Under favourable conditions, daincha will grow to a height of over 8 feet, and enough can be grown on one acre to supply sufficient nitrogen to manure about 4 acres of paddy. Sunn-hemp, being a smaller growing plant, will not yield so much green-manure, but even in this case the produce of one acre will answer for over 2 acres of paddy. Wild indigo and the grams being in comparison to the above ; only dwarf plants, the amount obtained from an acre should, unless the crop is very heavy, be applied to the land on which it is grown.

POTASH AND PHOSPHATE.

With regard to green-manures, it must be borne in mind that the potash and phosphoric acid they contain is obtained from the soil on which they are grown and in consequence no enrichment of the land in this respect is obtained. All that happens is that the potash and phosphoric acid present in the soil is taken up by the green manures crop and again returned to the land, but in a condition to be readily absorbed by the main crop which follows. Now, as the practice of green-manuring leads to heavier paddy crops it follows that ultimately more potash and phosphoric acid is removed from the soil than would otherwise be the case and the land in consequence will all the sooner be impoverished with regard to these two manurial ingredients. Provision must therefore be made to supply these ingredients to the land in the course of time, and this is best done by occasionally dressing the soil with such manures as "super" and bone-meal which are very rich in phosphoric acid and more occasionally still with wood-ashes, sulphate of potash, etc., manures which are rich in potash. The point to be remembered is this, that green-manures are not complete manures as they bring only nitrogen and humus to the soil.

† 1 Anna=1d.

GREEN LEAF MANURES.

Green-leaf manures, *i.e.*, leaf and branches cut off from plants growing on waste ground or forests and puddled into the soil have practically the same effect as green-manure crops, but they differ from the latter in so much as they supply potash and phosphoric acid in addition to nitrogen. They are complete manures and from this point of view are to be preferred to green-manure crops. If they can be obtained locally at a very cheap rate and in the requisite quantity it will be found more economical to utilize green manure crops grown on the land itself supplemented by a comparative small annual dressing of superphosphate or bone-meal.

Comparative tests with green-manures have been carried out at Coimbatore, with the result that green-leaf manure gave a yield of 4,490 lbs. of paddy and 5,811 lbs. of straw per acre, whereas, the same weight of daincha (grown on the ground) gave 4,200 lbs. paddy and 4,400 lbs. straw. The difference between the yields of paddy in the two cases is not great, considering the large yields obtained, but such as it is it is due to the extra potash and phosphoric acid brought to the soil with the green leaves, for when "super" is used in conjunction with a green-manure the yields obtained often exceed that obtained when green-leaf manure is used. Compared with the yields from plots receiving no manure which gave only 3,392 lbs. of paddy and 3,124 lbs. of straw, the efficiency of green manures and green leaf manures is undoubted.

A FINANCIAL COMPARISON.

Poonacs and fish manures are also bulky org nic manures which can be utilized with advantage where they are obtainable at a cheap rate. They contain a much larger proportion of nitrogen and other manurial ingredients than green manures and, consequently, can be used in much less quantity. Thus in an experiment carried out on the Coimbatore Farm to compare the relative values of these bulky organic manures 4,000 lbs. of green leaves yielded a profit of Rs 120* per acre, 4,000 lbs. of wild indigo Rs. 98, 400 lbs. of white castor poonac Rsi 109, 500 lbs. of black castor poonac, Rs. 104, and 560 lbs. of fish manure gave Rs. 114.

Poonacs are complete manures, and there is generally little necessity to use any other manure in conjunction with them

* R 1 = 1s 4d.

unless it is superior bone-meal to increase the proportion of phosphoric acid put on the land.

This mixture is generally very effective in increasing the yield of paddy, and the cost of the "super" needed for the purpose is comparatively small. On the other hand, fish manure is not a complete manure as it is practically devoid of potash and in consequence wherever the soil is deficient in that ingredient a mixture of sulphate of potash or wood ashes with fish manure can be used with advantage. The use of this mixture, however, should only be attempted after a small trial has given successful results, as not only is the potash expensive (thus reducing the profits) but unless there is actual need for it the tendency is to reduce the yields given when compared to fish manure alone. Thus the use of 560 lbs. of fish manure and 56 lbs. of sulphate of potash resulted in a net profit of only Rs. 82 as against a profit of Rs. 114 with fish manure alone. On the other hand, with one experiment in the Kistna delta, potash gave an actual increase in the profit obtained.

2. *Manures obtained from bones*, the chief of which are bone-meal and bone superphosphate, can under certain circumstances be used with advantage in manuring paddy. Bone meal is exceedingly rich in phosphoric acid, and, as a rule, contains a fair proportion of nitrogen; and at the same time it undergoes rapid decomposition in paddy soil and its manurial ingredients are thus quickly made available for plant food. To a certain extent, therefore, it conforms to the principles laid down on the first part of this article, but the amount of humus it can yield is exceedingly small and the best effects are produced when it is used in conjunction with a manure containing large quantities of organic matter, particularly with green-manures. In this case, the substances produced by the decomposition of the green manure assist the solution of the phosphoric acid of the bones and thus make the latter much more available for the plant than would otherwise be the case. The same strictures which apply to the use of potash manures with fish manures apply also in this case. Unless the soil is very deficient in potash, recourse should not be had to this ingredient owing to its tendency to reduce the yields and profits. Thus, at Coimbatore 500 lbs. of bone-meal yielded a net profit of Rs. 112 per acre, whereas, the same quantity to which 56 lbs. of potassium sulphate were added only gave Rs. 79.

SUPERPHOSPHATE.

Bone superphosphate is obtained by treating bones with sulphuric acid, by which the phosphoric acid is made soluble and when added to a soil is at once available as a plant food.

This manure is therefore a "quick-acting manure" and its effect is best seen when given in the form of dressings to crops already in the ground. Usually it contains some nitrogen in addition to the phosphoric acid but its value is mainly dependent upon the amount of the latter ingredient present and consequently with soils poor in humus such as are general in Southern India, it is best used in conjunction with the bulky organic manures. Thus, at Coimbatore, land manured solely with a green-manure crop grown on the land itself gave 2,814 lbs. of paddy and 2,691 lbs. of straw, whereas similar lands manured with the same green-manure crop plus 112 lbs. of superphosphate gave 3,733 lbs. of paddy and 4,043 lbs. of straw. The conclusion in this case is obvious, especially when it is noted that the large increase was due to an amount of "super," valued at less than Rs. 3.

It must also be pointed out that the use of comparatively large dressings of super does not yield a commensurable increase in the crop obtained, so that, except under exceptionable circumstances, a dressing of 112 lbs. of super to the acre is the maximum necessary.

3. *The mineral and artificial manures.*—These manures, which include superphosphate, ammonium sulphate and saltpetre, are (with the exception of the last) not of great importance to the *ryot*† owing to their comparative scarcity and high price. Saltpetre is produced locally in large quantities and as it contains both potash and nitrogen it is under certain conditions of cultivation a good manure, but the nitrogen being present in the form of nitrate, it is, as was shown at an earlier stage, not suited for paddy manuring.

AMMONIUM SULPHATE.

Ammonium sulphate is only produced in India to a very limited extent and is mainly imported from Europe, so that although it is a quick-acting manure and quite suited to paddy cultivation, the cost of the nitrogen is so great that at present it may be left out of account by the ryot.

† Peasant.

Superphosphate is prepared from mineral phosphates in exactly the same way that bone superphosphate is prepared from bones and consequently almost all that has been written regarding the latter applies to this substance also. It must, however, be remembered that unlike bone super it contains no nitrogen. Another phosphatic manure is basic slag and probably with a development of the steel trade in this country, it may become readily accessible to the cultivator. At present, however, it may be left out of account.

Lately, two artificial manures have been introduced in Southern India, namely, calcium nitrate and cyanamide and it is probable that in the near future they will be manufactured in this country. Of the two, so far as paddy cultivation is concerned, calcium nitrate is of little use, but cyanamide may possibly find an application as it yields ammonia in the soil and in consequence could be used to enrich the nitrogen content of low grade poonacs, etc. Experiments are now being carried out with this substance at Coimbatore.

THE JUDICIOUS COMPROMISE.

All of these artificial manures, it must be pointed out, do not fulfil the first condition laid down with regard to paddy manuring, *i.e.*, to supply organic matter to the soil; and consequently, although they can be used either alone or in suitable admixture with one another, the best results are obtained when they are used in conjunction with bulky organic manures. An exception may, however, often be made in the case of superphosphates, for when the soil is poor in phosphoric acid, a dressing of the substance has often yielded remarkably good crops, but even here it will be necessary sooner or later to supply organic matter if the enhanced rate of cropping is to be maintained.

In concluding this section it must be stated that many of the yields which have been quoted were not obtained the first year after applying the various manures. In reality the yields obtained have gradually increased with each annual application of manure, so that a permanent enrichment of the soil has taken place. Thus, when green-manure was first applied to a plot of paddy land on the Central Farm, a yield of only 2,400 lbs. of paddy per acre was obtained, but the next season yielded 3,500 lbs. and now after being annually manured for four years the yield is 3,900 lbs. Most of the other experi-

mental plots show the same increasing outturn and in one case the yield now obtained is 4,500 lbs. This result is most important as showing the possibility of producing a greatly increased fertility in paddy soils, but to obtain such results careful and systematic manuring is required. Spasmodic manuring at intervals of a series of seasons cannot bring this about and will only lead to a comparatively insignificant increase in the average fertility of the soil.

The Knowledge that is Power.

The first thing for a boy to learn, after obedience and morality, is a habit of observation—a habit of using his eyes. It matters little what you use them on, provided you do use them. They say knowledge is power, and so it is. But only the knowledge which you get by observation. Many a man is very learned in books and has read for years and years and yet he is useless. He knows about all sorts of things but he can't do them. When you set him to do work, he makes a mess of it. He is what you call a pedant, because he has not used his eyes and ears.

—Charles Kingsley : Lecture to the Boys of Wellington College.

The Educational Value of Experiment.

It was long a superstition that to pass in chemistry, all that was necessary was to have read some one of the small text-books, and a very large proportion of matriculants have doubtless had only such preparation. The fact is that hitherto our schools have been all but entirely in the hands of those who have had a purely classical or mathematical training, of men who have gained their knowledge by reading alone ; teachers thus trained cannot realise that the useful effect of science teaching is only attained when the instruction is carried out on entirely different lines : they cannot realise that accurate experimenting is the essential feature in the system ; that knowledge gained by mere reading is and can be of little use, as in acquiring it the mental faculties which it is desired to exercise never become trained. It must be recognised by all who have charge of schools that, in order to secure the due development of those faculties which science teaching alone can affect, the instruction must be imparted from the very beginning and during the entire period of the school career.

—Prof. Armstrong in " Suggestions for a Course of Elementary Instruction in Physical Science."

Lessons with Plants in British Guiana.

"*It is finding answers to questions which chiefly deserves to be called Science.*"—L. C. MIALL, F.R.S., in "Teaching and Organization."

By the Science Lecturer.

VI.

THE COMPOSITE FAMILY.

OUR last lesson led us to the discovery of flowers collected together to form a kind of head, and to-day we will proceed to a consideration of the great Natural Order *Compositae* in which this tendency has reached its highest development. As a type we may take the large and handsome Sunflower which is a favourite with many local gardeners although its size and conspicuous colouring make it rather dominant and aggressive so that the planting of it, to secure an æsthetic effect, must be done with skill and judgment. In many cases it grows almost to the size of a small tree; but does its stem ever become truly woody? At all stages of its growth it is well worth study, and it is particularly convenient as a source of material for the study of roots. Some of the many cultivated varieties, too, have interesting points which should be noted, while the downy hairs with which the whole plant is clothed make capital objects for the microscope.

A WARNING.

A preliminary study of the flower is sure to be a little disconcerting, but a closer examination conducted on the lines we have already laid down will soon clear up most of the difficulties. Here perhaps a hint may be given with advantage. Do not imagine that quickness in int-rpr ting the structure of a new and strange flower is something to be proud of and cultivated. Many students who have done good work in early observations get into the habit of glancing cursorily at a new specimen given them and reading it in the light of what they have already done. There can be no bigger mistake. It may be that a highly trained and skilled botanist can make a rapid and accurate examination, but no one is more careful than he

in declaring his results. He knows only too well the many traps into which he may fall, and that nothing may be more deceptive than superficial resemblances. Practice, therefore, should increase only the painstaking character of an examination.

Our sunflower blossom will present to us a large circular disc with what appear to be many bright yellow petals surrounding it, a number of stamens seemingly arranged in concentric rings, and a mass of what look like sepals supporting the great head. It will be difficult, however, to trace in this arrangement anything corresponding to the plan which we have found so constant in the flowers we have already dealt with. Let us try the effect of a vertical section which we have before now found so valuable for revealing structure. What does such a section reveal? Where is the ovary with its ovules; and what is the mass of tubular brown structures interspersed with semi-transparent dry bracts which covers the top surface of the *receptacle* which forms the centre of the head? Is it possible that each one of these is a separate flower borne in the axil of a bract? And is it possible that there may be two kinds of flowers in the head, the brown *florets* we have already mentioned and those bearing long yellow strap-like petals which are confined to the circumference of the disc? Careful examination should supply answers to these questions.

A CURIOUS CALYX.

You should have no difficulty, except in one point, in understanding the structure of little brown flowers, the *florets of the disc*. The corolla, stamens, and the pistil with the ovary will all be noted by a careful eye. But where is the calyx? It is evident that the ovary is inferior and that each floret is *epigynous*, *i.e.*, the corolla with the stamens seems to be borne upon the top of the ovary; and you will not fail to observe a "bulge" at the base of the corolla which possibly accommodates a nectary within. Two little bristly points, one on each side of and outside the corolla, are all that remain of the calyx. The natural retort to such a statement is, "How can one know that?" The answer is: "By comparing other flowers of the same Order and noting the gradual reduction of the calyx to such rudimentary structures as appear in the Sunflower." In some cases—a good example is the tiny "Soldier's Tassel" which grows wild on every dam—the calyx takes the form of a ring of fine hairs known as a *pappus* and this serves to support the seed as it is blown by the wind through the air.

In other respects a cross section of the Sunflower will prove fertile in instruction, for it will reveal florets in all stages of development. Are the youngest flowers in the centre or at the circumference? Which ripen first, the stamens or the pistil, and how exactly does the stigma appear? How many lobes has the stigma and how many carpels are there in the ovary? Are the stamens free or joined together, and is the arrangement the same in the filaments?

STERILE FLOWERS.

Now compare carefully the *florets of the ray*—the "yellow petals"—with the florets of the disc. How many notches or other indications of fusion can you detect in the yellow petal-like part? Do you find both stamens and pistils present; and do the ray flowers ever set seed? We have already become acquainted with diclinous flowers; may there not be such things as *sterile flowers* which are specialized for other purposes than that of reproduction—in this case, perhaps, to make the whole flower-head conspicuous and attractive to insects? Have you ever noticed insects visiting sunflowers? If so, what kind of insects are they, what do they seek, how do they go about it, and what effect do their visits have on the flowers? An interesting experiment to get an answer to this last question would be to inclose an unopened flower in a loose muslin bag or wire gauze cage in such a way as not to hinder its development but merely to prevent the access of insects to it, and to note whether or not the flowers set seeds.

THE SECRET OF SUCCESS.

The N. O. *Compositae* is the largest and most widely distributed families of plants in the world. In number of species it is rivalled only by the N. O. *Leguminosae*; and it is interesting to enquire what causes have led to this remarkable state of things. Again we must call attention to the fact that every flower has to struggle for its existence against tremendous competition, and for it to succeed something in the structure of the plant or in its physiology must give it a commanding advantage over its rivals. In many cases we are too ignorant of the factors which influence the life of a plant and of its extremely complex relations with its environment to lay our finger on just that point which gives the plant its saving advantage; but in the case of the two great families we have just mentioned there are some features which are so characteristic that they certainly seem to enable us to

understand how the plants in question have attained such wonderful success in life. It is well known that many of the *Leguminosae* harbour certain bacteria in nodules upon their roots, by means of which they are able to utilize the free nitrogen of the atmosphere and thus be independent of the nitrates in the soil. Now all nitrates are soluble in water, and they have not the power of entering into combination with the soil which certain other soluble salts have and so resisting the "washing-out action" of water. Heavy rain must, therefore, tend to rob the soil of its nitrates and so starve the plants which are dependent upon that source of supply for the nitrogen which is essential for their existence. It is easy to understand that plants which are independent of this source of supply must have a commanding advantage over less fortunately equipped rivals; and as a matter of fact we do find that probably seventy-five per cent. of the vegetation of the virgin forest of British Guiana is leguminous. The *Compositae* derive no assistance from root bacteria and they are by no means conspicuous in this colony; but on the other hand the structure of their seed apparatus is so excellent and effective—the ovaries of the flowers are so well protected, the mechanism for fertilization is so efficient, the massing together of a multitude of florets into one head is so economical of the assistance derived from insects, and the seeds can be so easily and so widely distributed—that the chances of any one plant propagating itself with success are immense: and experience shows they are realized in practice.

THE MEANING OF CLASSIFICATION.

One word on the subject of Natural Orders and families of plants before we pass on to consider a great division of flowering plants different in many respects from those we have investigated so far. Darwin's epoch-making work which established the principle of Evolution gave a meaning to the classification of plants which that had lacked up to his time. When it became clear that all plants existing to-day were descended from previously existing plants, and that the differences so evident amongst them had developed by variation acted upon by natural selection, the object of classification became to establish a Natural System which would group together the different forms according to their descent—would represent, in short, the ultimate twigs of a true genealogical tree. The position of the modern botanist may be illustrated in the following way: suppose an intelligent being of some sort—a

visitor from Mars, let us say—set down in British Guiana and, though quite unable to hold any communication with its inhabitants, required to classify the human beings in it. He would have little difficulty in distinguishing at least five divisions—Europeans, Blacks, East Indians, Chinese and Aborigines,—but he would find it harder to group satisfactorily the large number of people who exhibit characters more or less intermediate between these divisions ; and if more than one Martian scientist were occupied in the work it is probable that differences of opinion would arise as to the classification to be adopted and as to the precise value to be attached to certain characteristics, such as colour of skin, nature of hair, shape of skull, type of features and so on. Sometimes study would bring out the dominating value of a particular character ; for instance the persistence of curl in the hair would prove of immense value in tracing negro descent, just as in the *Leguminosae* the type of fruit and in the *Compositae* the character of the andrœcium are considered by botanists to indicate true natural affinity ; on the other hand an occasional aberrant feature, such as white skin in a negro (such cases exist in Georgetown to-day) would obviously not outweigh the accumulated evidence of other characters. Thus there exist *Compositae* in which the flowers are not grouped in a 'head.' This illustration is not a perfect analogy, but it will serve ; and we hope it will throw some light upon the difficulty which the beginner finds in understanding botanical classification. If it only enables him to grasp the fundamental fact that the way to study classification is not to learn off by heart the characters of the Natural Orders but to study as many flowers as he can and endeavour to classify them himself before flying to text books for assistance, we shall feel that a great point has been gained.

(*To be continued.*)

The Example of China.

A writer on China has remarked : "The contemplation of China is discouraging—to think it got so far so long ago and yet has got no further. The Emperor Hoang-li, who lived 200, B.C., may be supposed to have foreseen the deadening effect that government by literary men has upon a nation, for he burnt all their books except those that treat of practical arts."

—Prof. H. E. Armstrong in " An Appeal to Headmasters."

Some Notes on the Bee Moth.

By L. D. Cleare, Jnr

THE Wax Moths or Bee Moths (*Galleria mellonella*) locally called Moth Worms are without doubt the worst enemy of the apiary in British Guiana. They seem to have been originally inhabitants of Europe and Western Asia but are now spread practically over the whole world. So far as I have been able to ascertain they have been known in the colony for a number of years, practically since Italian bees were first introduced.

The moths appear to be most prevalent between the months of June and August, but will attack weak colonies at any time of the year.

Without examining the hives, the first indication of the presence of the moth-worms are small bits of substances, like fine dust, consisting of the excrement of the larvae, which the bees have removed from inside the hive to the alighting board. The damage is done wholly by the larvae which tunnel their way through the combs destroying the cells. If a careful examination of the combs be made, the larvae will generally be found either to be feeding on the combs between the front and back cells, or weaving silken threads over the entrances of these cells. This web is used both to protect the larvae against the stings of the bees and as a trap for the young bees which are unable to escape from the larval cell and generally die of starvation. The wax apparently forms the sole food of the moth-larvae.

LIFE HISTORY.

Whenever a hive becomes weakened so that the bees cannot protect it, the moths enter during the night and lay their eggs wherever they can, preferably on the combs.

The eggs are generally laid in small batches but can sometime be found singly. After a few days these hatch and the young larvae emerge and soon commence to tunnel their way through the combs destroying the cells and covering them with silken thread. When young, the larvae are a yellowish colour and when full grown a dirty white or dull greyish with very small tubercles, each bearing a fine hair. The head and

cervical plate are a chestnut brown. They measure about 25 mm. (1 inch) when fully grown.

The pupae, which are enclosed in a tough silken cocoon, are a light yellow-brown in colour, the back being darker with a minutely toothed ridge running along the mid-dorsal region. They measure about 10 to 15 mm. (about $\frac{2}{5}$ inch in length). The pupal period lasts about 12 days.

The moth itself is an ash-grey colour and has a wing expanse of from 25 to 40 mm. (1 to $1\frac{1}{2}$ inches). The females, as a rule, are larger than the males and can be distinguished by the shape of the outer edge of the forewing, which is almost straight, whilst in the males it is distinctly concave. The hind wings in the males are clouded.

PARASITES.

So far as I have been able to gather no parasites have been found in British Guiana up to the present, but two hymenopterous parasites have been recorded from Europe,* one a chalcid, *Eupelmus cereanus*, by Rondani in Italy, the other, *Bracon brevicornis*, by Marshall in France.

PREVENTION AND REMEDIES.

All local evidence goes to prove that strong colonies are never attacked, so the best preventative against this pest is good hives filled with strong colonies of Italian bees. Hives that are weakened through scarcity of food should be fed with thin syrup or honey, half-a-pint a day; but should the weakening be the result of the death of the queen or from swarming, the entrance to the hive should be contracted. Cleanliness is of the greatest importance: all cocoons and *débris* found in the hives should be burnt and moths and larvae destroyed. These measures must be continued until the colonies are strong enough to defend themselves against the attacks of the moths. Combs attacked by moth-worms, when the attack is not very severe, may be transferred to a strong colony. The bees will soon kill the larvae by stinging them to death, and in a few days they will have nicely cleaned up the combs and will soon start to rebuild them. Every larva found should be killed, care being taken to search all parts of the hives, including the bottom, for larvae which may have escaped from the combs.

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* A. Conte (Compt., Rend. Acad. Sci., Paris) 154 (1912) No. 1 pp. 41–42. Experimental Station Record, U S. Dept. of Agric., May 1912.

Stored combs are often seriously damaged. These may best be kept in a tight box and if necessary occasionally fumigated with carbon bisulphide; failing this the safest place for combs is in the hive. When storing combs in a hive they ought to be placed between the brood chamber and the 'supers' so that the bees will be obliged to pass through them when going in or out and so discover any larvae that may be in the combs and clean them out.

FUMIGATION WITH CARBON BISULPHIDE.†

"It is better to prevent moths than to destroy them after they get into your hives; but in case some of your honey contains moths you had better fumigate with carbon bisulphide. If you place a little carbon bisulphide in a shallow dish it will evaporate; and the fumes being heavier than air, they will go down. You should, therefore, put your honey in a tight box, or in some place where you can keep the air out, and then put the carbon bisulphide at the top. . . . . . . It is better to do the work in a large box in this way instead of in a room; for there is so much space in a room that, unless it should be an extremely small one, the gas would not be dense enough to kill all the moths, moth-worms, and eggs, unless you had quite a quantity of liquid around in several shallow dishes."

As carbon bisulphide is very inflammable this operation should be carried out in the daytime so that there will be no necessity for lamps; and no smoking should be allowed.

HIVES.

The bottom boards of hives ought to be made of one piece, where it is possible; but should it be found necessary to make a joint care should be taken to see that it is made to fit properly. Badly jointed bottom boards allow a crack in which moth-worms can hide themselves and the bees cannot follow them. Any other joints in the hive ought to be made to fit tightly so as not to allow any entrances for moths or hiding places for larvae.

I have not noticed any bee-keepers using patent "moth-proof hives" but they ought to be warned against these as the concensus of opinion is that these hives have more cracks and

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† Gleanings in Bee Culture November 1911, p. 699.

corners in which moths and larvae can hide themselves than the ordinary box hives.

OTHER ENEMIES.

A careful watch should be kept on the large toad or Crapaud (*Bufo marinus*) for these animals promise to be very troublesome enemies of bees in the colony. They come out at dusk just as the bees are returning to their hives, and should any of the insects drop to the ground before reaching home—which quite a number do—they are immediately snapped up by one of these hungry animals. A wire fence enclosing a well-weeded space of about 50 or 60 feet round the apiary should keep out the toads and so save quite a number of bees.

Through the courtesy of Messrs. John A. Cheong and C. L. Schüler, who were kind enough to place their apiaries at my disposal, I was enabled to make an examination of a large number of hives both in Georgetown and on the other side of the river at Vreed-en-Hoop and Best. From Messrs. P. M. de Weever and J. Rodway I obtained much useful information; to all I tender my acknowledgments.

Meetings of the Board of Agriculture

A MEETING of the Board of Agriculture was held in the office of the Department on August 23, 1912, His Excellency Sir Walter Egerton, K.C.M.G., presiding. There were present Professor J. B. Harrison, C.M.G. (Director), Mr. F. A. Stockdale (Assistant Director), Hons. Dr. J. E. Godfrey and J. H. W. Park, Messrs. F. Fowler, W. M. Payne, J. A. Raleigh, S. H. Bayley, J. Brumell, O. Weber, J. Wood Davis, T. Earle and the Secretary and the Officers of the Board.

On His Excellency's proposal Sir Frederic Hodgson who had been President of the Board for a very long period was elected an honorary member of the Board in addition to Mr. B. Howell Jones, C.M.G.

ACREAGE RETURNS.

The acreage returns for 1911-12 were laid over by Professor Harrison who remarked that they worked out at 68,704 acres of sugar cane, 36,000 acres of rice, 12,236 acres of coconuts, 2,838 acres of coffee, 2,127 acres of cocoa, 2,259 acres of rubber, 650 acres of limes and the usual 18,000 acres of minor products, ground provisions, etc. Rice had recovered its position. Coconuts had increased by 2,500 acres, coffee by 300 or 400 acres, cacao had remained stationary, rubber had increased by about 700 acres, and limes by about 300 acres.

A TOUR FOR THE GOVERNMENT BIOLOGIST.

Professor Harrison stated that the offer by the Entomological Research Committee to Mr. G. Bodkin, Government Entomologist, to enable him to visit the United States and study the methods adopted by the Agricultural Department there for controlling insect pests, was in the nature of a Carnegie scholarship of £20 a month during the period of six months Mr. Bodkin will be away, and a lump sum of £50 for travelling expenses. After various Committees had considered the offer a unanimous recommendation was made to the Government that it should be accepted and Mr. Bodkin had accordingly left for the United States. The present proposal was that he should go to Texas to the headquarters of the Entomological division of the United States Department of Agriculture which dealt with the agricultural affairs of the Southern States, should stay there for about

a month and then proceed to Louisiana and Florida. It was hoped that he would be able to visit also the experimental stations in Cuba and Porto Rico.

NATIVE HEVEA RUBBER.

The Professor said that at the Rubber Exhibition last year some rubber prepared from native Hevea (Hattie-*H. confusa*) trees was sent for show and had yielded a very excellent result on analysis :—Loss by washing, 1.4% ; caoutchouc, 92.3% ; resin, 1.8% ; proteid, 4.9% ; and ash, 1%. But at the same time the rubber was deficient in physical qualities, and was of less value than fine hard Para. This deficiency was due to the nature of the tree and the nature of the rubber. The trees from which it had been taken gave an exceedingly small yield and very soon ran dry. The lesson was to keep native Heveas out of the cultivations so as to prevent hybridization with the real Para—*H. brasiliensis*.

DEMONSTRATION PLOTS IN BERBICE.

Proceeding, Professor Harrison said the question of demonstration plots in Berbice had been very carefully considered. One station for cacao, 17 miles from New Amsterdam, for five years, would cost $137—half the cost of cultivation ; one for the study of plantain disease, 12 miles from New Amsterdam would cost the Government $96 ; one for coffee, $92, six miles from New Amsterdam ; another for cacao, six miles from New Amsterdam, on the Canje Creek, $92. They proposed to take over two or three acres belonging to farmers of the more advanced type and get them to cultivate in exact accordance with the methods recommended by the officer in charge of the work in Berbice. The Government would give the farmer a certain amount each year—practically half of the cost of cultivation—on condition that he followed precisely the advice of the Board. If he neglected to do so he would get nothing. The Board considered the scheme at the last meeting and if it now approved of the cost the scheme would be carried out.

His Excellency said that he should like to see a similar scheme very much nearer Georgetown—say in the Demerara river.

"THE THIN END OF THE WEDGE."

Professor Harrison said the proposal was what he might call 'the thin end of the wedge.' It had been proposed for Berbice first because Berbice had nothing in the way of an

experimental cultivation. In Demerara they had the Botanic Gardens and also operations at Christianburg; and in the other County they had agricultural stations. He would very much like to have one in the Canal district, Demerara. They had funds for the purpose as the vote of $1,000 made last year had not been put to any special purpose.

Dr. Godfrey said the Government had a considerable amount of land at Triumph which was very largely cultivated and might be a good district for an experimental field that would be of benefit to the people. He proposed that the Government should retain a piece of land at Triumph for a purpose of this sort. After some discussion the original scheme was approved by the Board.

SUGGESTED GOVERNMENT CITRATE FACTORY.

The Professor referred to the suggested establishment of a small citrate factory at Onderneeming. Some time ago the Government planted at Onderneeming close upon 20 acres of limes, and Mr. Bayley estimated that in a short time these trees would yield 72 barrels of lime, in 1913 some 1,120 barrels, and in 1914 some 1,900 barrels. The question was whether they should allow the limes to rot on the ground or try to convert them into citrate of lime as an object lesson to the people. After a good deal of discussion His Excellency suggested that Professor Harrison should prepare a scheme and that the Colonial Civil Engineer might assist with the estimate for the buildings. This suggestion was adopted.

SALES AT PLANT STALLS.

Mr. Stockdale reported that the sales at the plant stalls up to the 30th June, 1912, were as follows :—

Georgetown	1,187
New Amsterdam	1,433
Pomeroon	262
Suddie	107
Morawhanna	197

Whilst there had been 400 more plants sold at Georgetown than during the same period last year, the sales at the other places were slightly less, probably due to the weather conditions that prevailed during the months of April, May and June.

RESULTS OF RUBBER TAPPING.

Mr. Stockdale reported upon the results of tapping at the Government Experimental Station, N.W.D. In June the returns were not so satisfactory as in July, while the returns for August were more favourable even than those for July. They had taken Hevea trees which measured over 16 inches in girth, those under 18 inches having two basal cuts, whereas those over 18 inches had been tapped on the half herring-bone system. The rubber had been coagulated with acetic acid in the usual way, washed and rolled. He also tried some experiments with Sapium in June with a view to finding which would be the most satisfactory method of tapping the young Sapiums. The results were not very encouraging, as the Sapium latex did not run sufficiently to flow into the cups.

NEW YORK RUBBER EXHIBITION.

Mr. Stockdale reported that owing to the drought and other causes, the Colony could not send a representative exhibit worthy of the Colony, to the New York Rubber Exhibition but they were able to increase the exhibits in the British Guiana section at the Imperial Institute.

GLANDERS AND FARCY.

Professor Harrison reported that there had been cases of glanders and farcy in Essequebo, but they had been dealt with by the Veterinary Committee and everything was now satisfactory.

LICENCES AND PERMISSIONS GRANTED.

It was reported that licences to kill wild birds had been granted to Messrs. Alfred Cozier, Robert Cozier, M. A. de Freitas and Wm. Warfield, and that permissions to export wild birds' skins had been granted to Messrs. Booker Bros., Mc Connell & Co., Ltd., Mr. A. Summerson and the Curator of the B. G. Museum.

ANNUAL VISIT TO THE GARDENS.

On Monday, November 4, the Board paid its annual visit to the Botanic Gardens and Experimental Fields. His Excellency the Governor accompanied by his Private Secretary (Captain Napier) arrived at the avenue entrance to the Experimental Fields precisely at 3.30 p.m. and was met by the Chairman of the Board (Prof. J. B. Harrison), Mr. Alleyne Leechman (acting Assistant Director), Dr. Godfrey and Messrs. F. Fowler, H. L.

Humphrys, T. Earle, J. F. Waby and Agricultural Instructor Mansfield. The party proceeded at once to the office where they were joined by Messrs. E. F. Sayers, D. V. Jacobs, H. A. Matthews and E. S. Christiani (Secretary to the Board).

PRESENTATION OF A MICROSCOPE.

Prominent on the table of the Office stood the handsome microscope—a Fram instrument by Messrs. W Watson of High Holborn—which had been offered for competition by Prof. Harrison among all those who had obtained first classes in Agricultural Science and Hygiene since the lectures on those subjects were started—those in Government employ only excepted—and had been won by Mr. Edwin F. Sayers, head-master of Christianburg Scots School at the special examination held in September. Accompanying it was a box of fifty slides from a collection made by Mr. Leechman to illustrate local injurious insects with their parasites, the life history of the common mosquitoes of the colony, some points in animal histology, and a good deal of the anatomy of local plants.

In asking His Excellency to make the presentation Prof. Harrison said that he had offered the prize as an incentive to school teachers in the colony to take full advantage of the lectures on Agricultural Science and Hygiene. He then read Mr. Sayers' scholastic record which was remarkable as showing a consistently high standard throughout and proving satisfactorily that the winning of the microscope was not the result of "cram" or luck but was the consequence of steady work and perseverance. Commenting on the number of marks awarded, the Professor pointed out that Mr. Stockdale, the examiner, had been severe; in an ordinary examination the candidate would have been awarded probably 75–85 per cent. on his paper.

THE GOVERNOR'S SPEECH.

His Excellency, in handing over the microscope, said he had much pleasure in doing so and hoped that it would be of assistance to Mr. Sayers in continuing his studies. The record which had been read by Professor Harrison was one of which any teacher could be proud, and showed that Mr. Sayers had taken a real interest in his work. A very important portion of a teacher's work was the instruction of the children in science and agriculture. If that instruction were well given to the present generation it should have very considerable effect upon

agriculture in the next. He hoped that the handsome gift which had been presented by Prof. Harrison—although it could be won by one teacher only—had been an incentive to other teachers to study; in which case all would have benefited. He trusted that it would be possible to offer such prizes periodically as an inducement to teachers to do as much as they possibly could. He congratulated Mr. Sayers heartily on winning the microscope.

Mr. Sayers, in returning thanks, expressed the hope that Prof. Harrison would continue to take a kindly interest in agricultural education as he felt sure it was fraught with much good for the colony.

A TRIP ROUND THE EXPERIMENTAL FIELDS.

The party, which had now been joined by Messrs. Wood Davis and C. P. Gaskin, then inspected the bags of rice from the current crop which had just been reaped and had yielded remarkably well—something like 10 per cent. above the average. The best varieties again proved to be the "creole," which has given 44.5 bags of 120 lbs. of paddy to the acre, "No. 75" 42.7 bags to the acre, and "No. 6" 44.1 bags to the acre. A tour was next made of the Experimental Fields where the cane experiments were explained in an interesting manner by the Director. Proceeding along the fruit walk and the main avenue the rice fields were reached and in these His Excellency took particular interest. It should be mentioned that the poor condition of the Hevea and Sapium trees growing in this block is only what was expected. The experiment was started to demonstrate the inadvisability of planting rubber trees on the wind-swept heavy clays of the coast lands.

The Office was again visited and the opportunity taken of refreshment. His Excellency then proceeded to inspect the remainder of the fields and the cattle sheds. Here he had the opportunity of seeing two Guernsey heifers of very fine quality recently imported. Unfortunately the Plymouth Rock fowls (which competent judges have pronounced to be the finest ever sent to this colony) had already been forwarded to Onderneeming. His Excellency left by motor car just before dusk and the meeting broke up after a very pleasant and instructive afternoon.

Hints, Scientific and Practical.

How to Make a School Garden.

EVERY elementary school should have its garden. It is of course important for children to learn to read and write and to do simple sums, but other things are necessary to equip them for life, especially in those cases where the mass of the population is devoted to agriculture. They must be taught to observe; not only to see things but to understand what they see. The school garden, if properly managed, is one of the best means of training children in this way. There is yet another way in which the school garden may be useful. If the children are taught to do the work themselves, they will be taught to do things, not merely to know how to do them. The school garden, then, may be used to train children in observing, in reasoning, and in the capacity for doing things for themselves, all very important matters in after life. They can also be taught to be neat and methodical by making them keep the place neat and tidy.

If the soil is very bad quite a pretty little garden may be made with the aid of some kerosene tins. These cut open and with their edges neatly turned in will grow quite large plants, and if the tins are painted red will look very nice. I have seen some very good gardens with highly ornamental plants grown entirely in kerosene tins. But the ground is the proper place in which to grow plants, and even if the soil is bad it is not difficult gradually to improve it. Water must of course be obtainable near by. It is much better to start with a very small garden and gradually extend it than to take up more than can be properly managed from the start. If the winds are very strong and drying, the plants must be protected by hedges. Korakapalle (*Pithecolobium dulce*), Persian nimagathi (*Agati grandiflora*), big cactuses and the "aloes" growing along the railways are examples of such hedges, but prickly pear should be avoided and, if possible, there should be trees planted all around as well. It is much more important to have protection from the winds than to have shade from the sun, and enclosing the garden is very important to prevent the trespassing of cattle and people.

The main line of work should be to learn all about the way plants grow. Plants should be reared and examined at all stages from the bursting seed to the flowering and fruiting stages. The sowing of seeds in pans should be taught, with the necessary protection

against the sun, wind and rain. The seedlings when very tiny should be pricked out into smooth beds so as to leave just room for them to expand and make a few leaves. Then they should be lifted, each with a ball of earth around its roots, and put into the place for which they are intended. Beds should be formed with good gravelled paths between. The beds should not be too wide ; every plant should be easily reached from a path, because all treading on the beds should be carefully avoided. Flowers want a good deal of sun, but foliage plants will require some sort of shade. Shrubs should be planted round the outer part of the garden or here and there in the middle if there is plenty of room. Trees should be kept outside as much as possible, for their roots interfere with the beds. By this means you will have the brightly coloured flowers in the middle open space, foliage plants nearer the edges, and shrubs and trees forming the back ground. If possible a small patch of grass lawn should be added to set off the flowers, but it must be kept free from all weeds.

A careful plan of the garden must be made showing all its paths and beds, and this should be filled up with the plants growing in it every season. The children should be made to take part in every kind of planting. They should be taught to weed the beds and keep the paths clean. All weeds and leaves, loppings from the trees and garden rubbish should be put into a pit in a hidden corner with a layer of earth spread over every now and then. This weed pit is a most useful adjunct to a garden and, when the weeds are well rotted and their seeds destroyed, the leaf-mould obtained from it may be useful for potting plants or in improving the soil.

As great a variety of plants as possible should be aimed at ; for each will show something of interest and the children will learn something of the infinite variety in nature. The teacher will find it much easier, where there are many kinds of plants growing, to select just those for class work which are suited to the lesson of the day. By a well arranged school garden every part of a plant's life may be illustrated, the use of each organ, the causes of health and disease, animal and vegetable pests (which will always be present), the effect of the sun aud light, wind and shade, watering and drought.

—C. A. Barber (Government Botanist) in "Madras Agricultural Calendar" 1911-12.

The Advantages of Drainage.

EVERY cultivator knows that if crops are to be grown successfully, one of the most important points to be considered is the question of water supply. The question of drainage is equally important.

It may at first seem absurd that, after having incurred expenses either in digging a well or in acquiring the right to irrigate his lands from a tank or a canal any one should go to the further expense of constructing drains, merely for the purpose of leading the water so obtained away from the fields again, where it will be of no further use to the crop. There are, however, several advantages to be gained by good drainage which need only to be pointed out to be appreciated.

Any one who has observed crops will have noticed that if during the earlier stages of growth, water is allowed to collect and stand in the low-lying portions of the fields, the plants in these places are always pale, stunted and unhealthy looking, and that at the time of harvest if that yield any grain at all it is only a very small quantity. A similar appearance is noted in the case of irrigated crops such as sugar-cane or turmeric, and even paddy will present an unhealthy appearance if the fields are submerged to too great a depth or if water is allowed to stand for too long an interval at a time.

In all these cases the cause of this appearance is excessive moisture. It is, however, sometimes stated that it is due to lack of sun, but that this is not the real reason is shown by other plants in the same field being green and vigorous although they do not receive any more sun than the unhealthy plants. Besides requiring moisture, plants must have air. When flooding occurs the air is driven out of the soil, water takes its place and the land is then said to be water-logged. Under such conditions the roots cannot get air and they are unable to grow and spread in the soil as they ought to do, hence the plants present the appearance described above.

Again it is observed, more particularly in the case of the irrigated crops already mentioned, that besides giving a poorer yield than those grown under more arid conditions, crops that have been subjected to this treatment seem to exhaust the soil more and in time of drought are the first to show signs of suffering from lack of moisture. The reason for this is obvious.

Since the channels are kept flooded, the roots of the plants are unable to penetrate deeply into the soil but are restricted to the upper layer for their supply of food. As a result they remove

much more plant food from this layer than a deeper rooted crop, which is not confined to such a limited area for its supply and, therefore, the crop appears to be an exhausting one. As an instance of this the case of paddy after sugar-cane may be mentioned. It is never expected that a good yield will be obtained from the first crop of paddy taken after a crop of sugar-cane. That the yield is poor is simply because for the reasons given above—the sugar-crop has been compelled to become a surface feeder to the detriment of the succeeding crop. What has been said with regard to food supply applies to moisture. In time of drought the surface layer is the first to dry up and with it (unless irrigation can be done) the roots of these plants which have been prevented from striking deeper. Thus while a deep-rooted plant, drawing upon the supply of moisture stored up in the lower depths of the soil presents a fresh and vigorous appearance, the shallow-rooted plant is withering and dying.

Further, it is well-known that when land is newly brought under wet cultivation, it very often yields well. After a time, however, it begins to appear alkaline and the yield falls. This goes on until the land becomes so alkaline that the crops fail altogether and cultivation has to be abandoned. In such cases it is usually noticed that while care has been taken to arrange proper means of irrigation very little or no attention has been paid to the facilities for drainage and in consequence this unfertile condition has resulted. These are a few of the disadvantages of defective drainage ; it will be noted that they tend to diminution of yield, even to total loss of the crop and to waste of water.

The following recommendations are therefore made :—

(1) *Dry crops.*—Where the land is of a clayey nature and therefore likely to be water-logged during heavy rains, attention should be paid to the natural drainage channels to see that they are free from obstruction. Small depressions should be levelled up, but where larger ones exist trenches should be made to connect them with the drainage channels. These trenches should be about 1 foot in width and of sufficient depth to drain the depression completely. Where isolated fields of dry crops are cultivated in wet land areas, a trench of the same width as already indicated and as deep as the level of the ground will permit should be made all round the field to intercept and drain away the water which percolates through from the wet lands.

(2) *Irrigated crops.*—The advantages of good drainage in the case of the sugar-cane crop were dealt with in an article in last

year's calendar. What was said there applies equally well to other crops, where the system of beds and trenches is adopted. Where irrigation is done by means of furrows, these should be straight, of uniform slope and should lead into a drain of slightly greater depth, and care should be taken that this drain is kept free, otherwise water will stagnate in the furrows.

G. R. Hilson,
Deputy Director of Agriculture,
Northern Division, Madras.

—"Madras Agric. Calendar," 1911-12.

The Scholar's Shame.

Bearing in mind the respect we pay to Chinese institutions—as shown in our adoption of their system of literary examinations as a condition of entry into our Civil Service—and that we are at the present time engaged, through the agency of various public examining bodies, in seeking to compel the nation generally to adopt the system, we might surely go a stage further and accept the wise direction of an enlightened Chinese statesman when he reminds us that 'a thing unknown is a scholar's shame.'

—Prof. Armstrong in "An Appeal to Headmasters."

Agricultural Instructors' Reports.

BERBICE.

Mr. Instructor Augustus reports, after a visit to the Upper Canje Creek, that he found a slight improvement in the cultivation of the farms there and that some of the principal farmers are adopting the advice given them. Many have bought forks for the purpose of carrying out a better system of tillage and are pleased with the crops of cassava which had resulted from the thorough use of this important tool. Acoushi ants are doing serious damage in the district and the people are giving up the cultivation of plantains and ground provisions for that of rice as that crop does not suffer from the attacks of these insects. A meeting of farmers was held at Baracara which gave the Instructor an opportunity of clearing up many important points.

POMEROON.

Agricultural Assistant Matthews reports from the Pomeroon that ground provisions are looking healthy and that the coffee and cocoa plants recently introduced on certain farms are coming on splendidly. On one grant of 13 acres the coconuts are dying out. The owner attributes this to bud-rot, but, as the Instructor points out, bad drainage is really the cause. Latterly an attempt has been made to establish better drainage and in consequence fewer trees have been lost. Advice was given as to the cutting down and burning of affected plants, the selection of nuts and the proper spacing of the young trees. It is distressing to notice that on certain farms the urgent advice given to cut out and destroy all affected coconut palms has not been followed.

Rubber is doing well but the Sapiums have not withstood the drought so well as the Heveas.

NORTH WEST DISTRICT.

Agricultural Instructor Abraham reports from Issorora Experiment Station, N.W.D., that the weather conditions for the three months up to August were very favourable for plant-

ing purposes, and that this circumstance was taken advantage of by the homestead farmers and small holders. Coffee has been in great demand, especially the Liberian and the Robusta varieties, and large orders have been sent to the Department for supplies of seedlings. When planted out the seedlings have done well. The creole coffee trees were in full bearing but were somewhat neglected. Cacao seedlings have suffered severely from the drought. The cornstalk borer is reported as doing damage to the maize crop in some places but ground provisions are in a healthy condition. The attacks of the cornstalk borer have been utilized to emphasise the mistake of planting large areas with one crop only.

A L.

The Spirit of Research in the Laboratory.

Tait's laboratory was an endeavour to counteract the baneful influence of the old system. He saw that mere book study in science was incomplete, that practice in measuring and in using instruments did not suffice to complete it, that the only way to get out of science study the great educational benefit it was capable of affording was to study it by research and that only thus could the study of science be made to exert its full influence, whether on the individual or on the national life. He doubtless saw that the wide employment of the textbook and the written examination in British schools and colleges must prevent the cultivation of resourcefulness and insight in science study, and that as the growing importance of science gave it a large place in the curriculum, the continued use of the old method must more and more diminish the initiative of the British people. And so he encouraged his students to become investigators and set them in his laboratory to find things out for themselves.

—Prof. Macgregor (Edinburgh University).

The Model Gardens.

RECORD OF ATTENDANCES.

Below is given a table, arranged in quarterly periods setting out the number of pupils who attended the Model Gardens of the colony from April 1, 1907. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to March 31; April 1 to June 30; July 1 to September 30; and October 1 to December 31. The totals only during 1907 and 1908 are given; the records since then are in detail.

QUARTERS.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1907.										
2nd to 4th	1,261	928	994	835	556	...	...	...	...	4,574
1908.										
1st to 4th	5,447	3,386	1,477	887	1,053	160	...	...	...	12,410
1909.										
First	1,638	710	338	463	370	302	...	...	...	3,821
Second	1,707	677	329	142	288	446	...	...	...	3,589
Third	¶1,252	742	433	436	172	378	223‖	...	...	4,636
Fourth	1,876	536	438	236	362	771	439	...	...	4,858
1910.										
First	1,282	769	287	370	259	489	465	..	...	3,921
Second	1,311	558	787	894	303	455	519	403§	...	5,240
Third	¶1,234	526	910	748	294	510	498	537	...	5,257
Fourth	1,209	444	1,285	336	295	493	502	592	...	5,156
1911.										
First	1,086	360	1,042	838	312	514	414	572	577	5,695
Second	1,263	326	713	816	286	292	536	591	688	5,511
Third	¶1,093	385	910	627	361	297	543	441	639	5,296
Fourth	1,687	448	935	588	447	406	737	957	540	6,745
1912.										
First	1,127	379	1,374	1,034	425	207	573	359	423	5,901
Second	1,385	359	1,096	900	484	553	730	461	413	6,381
Third	1,416	400	763	889	412	572	621	616	443	6,132

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

¶ Schools in vacation during August.

‖ Instruction commenced in July.
§ Instruction commenced in April.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to Oct. 13, 1912. The corresponding figures for the three previous years are added for convenience of comparison :—

Product.	1909	1910	1911	1912.
	Jan. 1 to October 13.			
Sugar, tons ...	62,002	46,920	52,835	32,736
Rum, gallons ...	1,322,195	1,626,480	1,542,067	1,504,467
Molasses, casks ...	426	631	879	906
Cattle-food, tons ..	5,799	4,751	3,287	3,111
Cacao, cwts. ...	533	443	798	102
Citrate of Lime, cwts.	49	76	56	·5
Coconuts, thousands	450	681	682	943
Copra, cwts. ...	423	210	1,038	963
Coffee, cwts. ...	1,120	978	925	1,225
Fruit, brls. and crates	1	...	..	...
Ground Provisions, value	$216 32	$546 12	...	...
Kola-nuts, cwts. ...	38	9	...	...
Rice, tons ...	3,741	4,141	1,883	2,365
Rice-meal, tons ...	1,448	1,555	974	1,484
Starch, cwts. ...	...	4	..	...
Cattle, head ...	789	1,049	832	434
Hides, No. ...	2,549	4,574	3,152	3,025
Pigs, No. ...	708	872	1,013	997
Poultry, value... ...	$ 184 20	$ 67 08	...	...
Sheep, head ...	53	122	40	61
Balata, cwts. ...	5,647	6,570	5,712	2,287
Charcoal, bags ..	61,772	71,222	55,956	52,099
Firewood, Wallaba, etc., tons ...	6,709	7,509	8,130	7,320
Gums, lbs. ...	6,512	1,507	3,246	3,041
Lumber, feet ...	175,622	202,027	310,131	155,423
Railway Sleepers, No.	2,500	5,700	3,920	4,046
Rubber, cwts. ...	45	12	23	2
Shingles, thousands	1,332	1,802	2,035	1,667
Timber, cubic feet	221,066	222,681	161,556	244,940

Selected Contents of Periodicals.

Laying Out a Coconut Plantation.
The Coconut Palm
Cost of India-Rubber Production in Malaya.

—The Tropical Agriculturist, September, 1912.

Two Ceylon Problems: Address by Mr R. N. Lyne (the new) Director of Agriculture to the Ceylon Agricultural Society, July 3, 1912.
Bee Warfare.
The Giant Orchid.

—The Tropical Agriculturist, August, 1912.

The Eye of the Domestic Animal and a few of the Diseases affecting it.

—A. J. of the U.S. Africa, August, 1912.

The Willow Tree Caterpillar.
The Green Peach Aphis and its Control.

—The Agricultural Journal of the Union of South Africa, September, 1912.

The Prevention of Malaria.
Quarantine.
Ankylostomiasis.

—The Colonial Office Journal, October, 1912.

The Coconut and its Commercial Uses, II.

—Bulletin of the Imperial Institute, July, 1912.

Lawn Grasses, Lawns and their Treatment.
The Care of Pot Plants.
Preliminary Notes on Tapping Experiments at Kuala Lumpur.
Rubber in Malaya, 1911.

—The Agricultural Bulletin, F.M.S., September, 1912.

JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL VI. JANUARY, 1913. No. 3.

Rubber Disease—A Warning.

THE September bulletin of the Agricultural Department of Surinam* contains an important article by Dr. J. Kuijper on a disease of *Hevea brasiliensis* which has appeared in the Dutch colony and seems to be doing some damage. As early attention to cases of this sort is of the highest importance—prevention of disease being a good many hundred times better than cure—we take this opportunity of bringing the matter to the notice of our readers and urging those of them who are interested in rubber to keep their eyes open for the very first symptoms of any similar trouble in British Guiana.

The disease takes different forms. In one, transparent olive-green or dark-green spots appear on the young leaves, which may eventually become almost entirely black and crumpled up, until the top of such an infected plant displays nothing but a number of black dead leaves. In some nurseries every bed and every plant, almost, may be more or less attacked.

Hevea leaves grow fast and it appears as if the fungus which is responsible for the disease cannot attack old tissue; consequently if young infected leaves mature the primary spots die off while at their edges black points develop, often in such numbers as to form black rings. This is the commonest form of the disease—black spots and rings on full grown leaves.

The third form may be seen on the leaf-stalks and the young branches as thickened black areas. A green knob develops first;

* Department van het Landbouw, Surinam; Bull. No. 28; Sept, 1912. Een *Fusicladium*-Ziekte op Hevea: door Dr. J. Kuijper.

this bursts, and a black streak follows which develops into a canker-like spot; which however must not be confused with true Hevea canker.

Microscopical investigation shows that the disease is due to a species of *Fusicladium* which has been named by Dr. Kuijper *Fusicladium macrosporum*, as the conidia are the largest which occur in this genus. The fungus has proved exceedingly difficult to grow artificially and several points concerning it have still to be cleared up. Dr. Kuijper is, however, continuing his investigations, but it seems already clear that infection takes place through the young leaves whence the disease spreads through the whole plant. The glands at the base of the leaves are particularly attacked and then the stalk and the stem.

The disease occurs all over Surinam and has been discovered on many plantations situated on the Commewyne and Surinam rivers, along the railway and even on plantations in the virgin forest 38 miles from the coast; but Dr. Kuijper assures us that only weak trees are attacked and that the danger done on the whole is not very serious.

Hevea guyanensis is also affected by the disease. On some plantations six-year-old trees have been attacked and killed; the tops of the branches sicken, the leaves fall off and the new leaves and even the new shoot are diseased. Even when the branch appears sound at first, infection develops later, and the plant appears so weakened by the loss of its leaves that it fails to recover. In such cases the only course seems to prune quite back or even to cut the tree right out. It must be noted that the death of branches may be caused by other fungi.

Where the disease occurs in nursery beds it is apt to be destructive, especially where the plants in the beds are close together. In most cases the trouble partly disappears when the leaves fall off and the new shoots develop, but nevertheless the stems may be attacked and the typical canker spots appear from secondary infection. Whenever a plant with a canker spot or with old leaves with the black specks appears in a bed, one can be sure that such a plant will develop new diseased leaves. It is well in such a case to prune off the infected branches, but it is far better not to plant the beds too thickly and not to leave the plants too long in them. Badly infected beds may be sprayed with Bordeaux mixture though Dr. Kuijper does not think that treatment absolutely necessary; but he is emphatic as to the danger of too thickly planted beds.

Notes.

Modern Ideas in Primary Education.

In view of the articles on "Science as a School Subject in British Guiana," which we are publishing in *The Journal*, Mr. Nawijn's account of the method of teaching the ordinary Code subjects in his primary school in Paramaribo are of great interest. The whole subject of primary education in the West Indies and Guiana is a very difficult one, and we think it wlll be generally conceded that the problem of getting the best results from the material available has not yet been solved. Every effort in this direction therefore must have the sympathy of those interested in the welfare of the people, and we heartily commend Mr. Nawijn's essay to the careful consideration of our readers. That his method is revolutionary will be conceded, and the results of it are not yet definite enough perhaps to convince the critics; but we are satisfied that it is sound in principle and realises the ideal of true education—which is to "draw out" all that is sound and good and able in the pupil and not merely to fill him as full as possible of information. We understand that the introduction of this new method has been undertaken by the Dutch Government as an experiment and that it has been a step by no means welcomed by the general run of teachers. But the Commission which so recently investigated Surinam and its conditions was not, we hear, altogether satisfied with the state of education in the Dutch colony, and we imagine this new move may have been inspired from Holland where education, thanks to Dr. Bos, the President of the Commission, has been reconstructed on thoroughly modern lines. We hope to procure from Mr. Nawijn further details as to the working of his school and to publish them in some future number of *The Journal*. The article is printed just as it was received; and it only remains for us to congratulate our correspondent on his command of English and his facility in that language.

International Association of Tropical Agriculture and Colonial Development.

At the request of Professor Wyndham Dunstan, F.R.S., we have pleasure in drawing attention to the following:—

The International Association of Tropical Agriculture and Colonial Development was founded at the close of the first International Congress of Tropical Agriculture held in Paris in 1905. The object of the Association is the promotion of

the scientific and practical study of all questions connected with tropical agriculture and the development and utilisation of the natural resources of the Colonies. The President of the Association is Professor Wyndham Dunstan LL.D., F.R.S., Director of the Imperial Institute, who was elected at the close of the International Congress held in Brussels in May, 1910. The Association has its headquarters in Paris and is governed by an International Board, from which an Executive Committee of from five to seven administrators is selected.

The work of the Association is to promote investigations into questions of special importance to tropical agriculture, to publish the results of these inquiries, and to organise International Congresses for the discussion of the problems of Tropical Agriculture and Colonial Development. Two Congresses have been held already and it is proposed to hold the third Congress in London in 1914.

A British Section of the International Association has now been formed, which will be responsible for the organisation of the Congress in London. The work of the Association is not only of interest to Departments of Agriculture and Forestry but also to planters and to merchants and manufacturers who are concerned with tropical and colonial raw materials, and it is hoped that all those interested in these important subjects throughout the Empire will join the British Section of the International Association.

The annual subscription for members of the British Section of the International Association is one pound, payable on the 1st January in each year. Members of the British Section will have the privilege of taking part in the London Congress without further special payment. They will also receive all the publications of the International Association. In addition, the quarterly "Bulletin of the Imperial Institute" will be issued to them free of charge. A reading and writing room will be reserved at the Imperial Institute for the use of members of the section when in London, and members will also be entitled to make use of the General Library and Reading-rooms of the Imperial Institute. Letters and subscriptions should be addressed to "The Secretary, British Section, International Association of Tropical Agriculture and Colonial Development, Imperial Institute, London, S.W."

Elementary Education in Surinam.

By Tj. Nawijn, Headmaster, Emma School, Paramaribo.

For many years people have complained about the schools in Surinam, and among the discontented ones were some members of the "Colonial States," the Parliament of Surinam. These members frequently insisted that improvement was necessary, and finally on the 10th November, 1909, the Governor appointed a commission, which was charged to advise how the instruction should be carried on. In the report of this commission we read :—

"The tendency of our teaching is on the whole too theoretical and too little practical; it teaches the children much they could do without, and withholds still more which they decidedly need in their later life. . . . . . The Education regulations do not sufficiently take into account the interests of the community. For those interests it is not sufficient that the future citizens should learn to read and write with efficiency and also have a knowledge of one or two other accomplishments, but (and perhaps this is of even greater importance) they must learn to use their physical and mental powers.

* * * * * *

It has frequently been remarked that the people of Surinam dislike work in general, and agricultural work in particular and it has been said that it is the duty of Education to cultivate the love of work. It is certain that the present teaching in regard to this does not do as it might, though teaching is not all-powerful. In the first place it is not legislation, but the character of the teaching that is to blame for this state of affairs, and the character of the teaching depends almost entirely on the capabilities of the teachers and their devotedness to their work."

The opinion of the "Surinam Teachers' Union" with regard to education in the country districts is remarkable. "The education is not practical enough because it is in most ways an imitation of the teaching in the town and therefore lacks local colour; it does not correspond with the environment because Dutch reading books are employed; counting and

object geometry are taught first theoretically, by Dutch books, instead of practically; geography, history, and natural history are often very wrongly taught."

THE PRINCIPLES OF TEACHING AT EMMA SCHOOL.

The Government of the Colony is diligently striving to improve education, and pending further measures the Governor has decided that the instruction at one of the schools shall be so re-organised as to fulfil better than before the requirements of business life. This school, the Emma School, is an ordinary elementary school for boys and girls of the lower classes, and the re-organised instruction is based upon the following principles:—

1. It is wrong to develop only the intellectual powers of the pupil; the training of the eye and ear and of the physical powers generally must proceed parallel with, and aid, the intellectual development.

2. The mental powers of the child are most successfully trained by self-activity.

3. Because profound knowledge is based upon facts and not upon words, instruction should begin as much as possible with the object itself.

4. Everything that a child learns and does must be done well.

5. As long as the child is a stranger to his own environment, it is useless to endeavour to teach him outside things.

6. Education is most likely to answer to the requirements of life when the teaching matter is borrowed from everyday life.

If the conceit consequent on letter-and-word-knowledge is anywhere apparent, it is surely in Surinam. In the Emma School this method of teaching has been replaced by a knowledge of things based upon actual experience and observation.

THE FIRST STAGES.

The first class is a Froebel class. There various simple objects and geometrical figures are cut out of paper, weaving is done, all kinds of figures are made from coloured wood

mosaics and rings, objects are modelled in clay, drawing and singing are both taught and imitation plays are acted and gesticulations practised. For the rest, the teacher lets the children play with the gifts of Froebel. Many lessons in speaking are given, and the vernacular language, the "Negro English," an impediment to the national development, has been completely expelled from the school. Last year the teacher of this class was a Dutch Lady who did not understand "Negro English," yet she had brilliant success with her instruction in speaking. In a very short time the little children understood her quite well and they expressed themselves fairly well in Dutch. The three "R's" are not taught at this stage. Some people were afraid that the instruction given in this class would not be sufficient to lead up to the second class but results have proved that these fears are ungrounded.

MANUAL TRAINING.

In the next classes the Froebel instruction has been replaced by object-teaching and manual training. The manual training includes working with clay, paper and paste-board and later on, carpentering. Object-teaching means teaching by observation, *i.e.*, to observe surroundings accurately and to learn to know them, the extent of the surroundings being gradually increased as the minds of the pupils expand. Teaching by observation begins with the schoolroom. Several things are shown there and spoken about, *e.g.*, the floor, the planks, supports and beams, the nails, the walls, the doors, the windows, and window-frames, blinds, ceiling, staircase, the tools of the carpenter, the tree which gives the wood, the school benches, the book-case, the table, the chair, the black-board, the bead-counting frame.

After this, features are taken outside the schoolroom. Several other things must have their turn now, *e.g.*, the passage, the clothes pegs, the front door, the back-door, the steps, the playground; then the different things in the playground, *e.g.*, the trees, the plants in the garden, the water tanks, the pump, the gutter along the playground and the direction of the streaming water in it.

Still later on other things outside the school premises are noticed, *e.g.*, the shop next the school, the street, some of the principal buildings in the neighbourhood, afterwards the shoemaker and his work, the tailor, the blacksmith, the iron-

monger, the baker, the dressmaker. Then the different parts of the body are studied, in so far as they can be outwardly observed, and gradually the teaching goes further still: remoter objects are studied, the streets and squares of the city, the river, with the ebb and flood tide, the drainage, a sluice, different native plants and animals, and types of people. The objects discussed are as far as possible searched for and observed, and for this purpose excursions are made.

Manual training is connected with teaching by observation. The various objects are modelled in clay, paper, pasteboard and wood. So in the second class the little ones model in paper the floor with its planks, a window, a door, etc. These objects are first measured and drawn on a small scale; and it is remarkable how soon the children in this way learn to use paper, pencil and ruler.

CORRELATION OF SUBJECTS.

The different branches of tuition are as much as possible connected with each other in order to make the learning easier. So, for example, manual training and teaching by observation are connected with drawing, counting, reading, grammatical instruction and singing. This is very easy, because there are plenty of points of contact. Take for example the floor. After it has been measured, the planks are counted and the length and breadth are compared by seeing how many children can stand in a row; by reading, lessons can be given about the wood, the carpenter, or the tree; the mice which are hidden beneath the floor give occasion for grammatical instruction; and a little song is learned about them. In such ways all the branches of teaching are connected and the facts learned are fixed in the mind in a natural manner.

For reading, letter cards are used at first; for counting, little sticks are employed by which the children can control themselves until they can dispense with such artificial aid.

GEOGRAPHY CORRECTLY TAUGHT.

In the highest classes the teaching by observation changes almost imperceptibly into geography, natural history and history. In all these subjects care has been taken to introduce what is most practical. The geography of Surinam is correctly taught; the drawing of maps is prepared for by modelling streets with pieces of wood or match-boxes to represent houses.

In the play-ground the teacher has the children facing the north. Then a street or river is drawn on the ground, and finally the map is drawn on the blackboard.

So learning goes forward step by step, and the teacher always takes care that every name learned by the children represents an idea.

The plantations in the neighbourhood are visited, the tools of the balata-bleeder are shown to the children, and in the school there is a picture of the rapids in the river. A steamer of the Royal Dutch West Indian Mail is visited and there everything that is imported or exported is noticed.

Later when the geography of other lands is introduced the routes of the different steamship lines which touch Paramaribo are studied.

In all the teaching attention is particularly given to that knowledge in which Surinam cannot afford to be lacking. Especially is this the case in teaching natural history of which horticulture is so important a branch.

THE SCHOOL GARDEN.

It is a matter of the highest importance that the people of Surinam should return to agriculture, yet many consider this as an inferior occupation.

A part of the ground of the Emma School is occupied by a school garden. For the present it is small, but a proposal has been made to extend it as soon as circumstances will allow In this garden the children work; and as far as possible, those who desire it have received a plot of ground for themselves, where they may plant anything they wish. The products are their own property. It is interesting to see the results. The children are so fond of the work that in play-time everyone speeds to his little garden to do something for which he has had no time before.

It is found to be scarcely necessary to work in the garden in school-hours, and the children are proud when they can take their harvests home. In this manner the children work in the school garden of their own free will and they are most ambitious, as indeed it was hoped they would be. The teachers have plenty of opportunity to give hints and these the children are anxious to follow as they expect profit from them.

By this short description it can be seen that in the simple manner of working at Emma School, the children are so occupied that they "reveal themselves" in their work, and the teacher can know and control them. This is evident in all the work, especially in manual instruction and the garden. Then comes the question, "Is not this method of teaching more expensive than what was previously given in the Emma School, and which is still given in the other schools?" The answer is "No." In one sense it is even cheaper, for it is possible to draw more profit from the great expenses necessary for education.

Precautions in making Copra.

It is a strange and deplorable fact that until very recently almost all the copra of the world was made by drying either in the sun or over a smoking kiln. Such copra cannot keep well—which means that millions of pesos have been lost through the loss of oil by decomposition in storage or on the half-way-round-the-world shipping routes. Oil turned into rancid substances and acids is irretrievably gone—it cannot be recovered in the factory once the moulds have split it up. The moulds are aesthetically pretty to look upon, with their green and brown and yellow spores, but from the dealer's point of view they are hideous, and they rob his pocket.

It appears that German Samoa was the first country to take decisive steps towards the standardization and improvement of the copra export. Within the last decade the copra industry there has been put upon a firm footing and there is probably no more up-to-date copra country in the world at present. The Government realized that it was necessary to have not only a proper drying apparatus, but the proper sort of coconuts as well, and accordingly regulations were prescribed obliging all copra dealers and agents to obtain from the Government a permit, which is non-transferable and which may be cancelled in case of non-compliance with the regulations. Furthermore, it is forbidden to pick the nuts—which means that only the dead-ripe nuts that have fallen from the trees are used for the copra, thus obviating one of the greatest faults of the Philippine copra industry—the use of the unripe nuts.

—The "Philippine Agricultural Review," May, 1912.

The Profitable Planning of Coconut Plantations.

By Prof. J. B. Harrison, C.M.G., M.A. (Director of Science and Agriculture) and F. Fowler, F.G.S. (Commissioner of Lands and Mines).

THE following directions for laying out and planting coconut plantations were drawn up by a Committee of the Board of Agriculture and published in "The Official Gazette" of October 5, 1904.

SELECTION OF SEEDS.

Nuts which are quite ripe should be chosen from trees which bear good crops of nuts having thin husks and thick kernels (copra), and which are neither very young nor very old. They should either be picked and not allowed to fall, as by so doing they may be injured, or, if not picked, fallen ripe nuts should be selected with uninjured husks; they should be kept a month before sowing. The larger ones on the bunches should be selected for planting, but very big nuts are not always the best, because only a few may be borne on the tree, while frequently their size is due to excessive development of husk at the expense of the kernel; oblong nuts should be avoided. The large orange-red variety is the best for planting, in view both of size of coconut and of yield of copra.

SOWING.

Trenches should be dug about six inches deep in good, light soil, and the nuts placed in them on their sides about six inches apart, with the bigger ends slightly downwards. Ashes should be placed in the trenches to keep away insects. The nuts should be half-covered with soil, and over all should be put about six inches of grass or cane trash. In dry weather they must be watered every two days. Some of the nuts may not germinate, but in five to eight months those that have sprouted and have shoots about eighteen inches high will be ready to plant out.

PLANTING OUT.

At distances of about two-and-a-half rods apart, in good loamy soils, dig holes 3 feet wide and about 2½ feet deep. In poorer sandy soils the holes should be dug closer, but not less

than two rods apart. The soil should be taken out of the holes, thoroughly mixed with well-rotted manure or ashes, and then put back again so as to fill them to within six to eight inches below the level of the earth. The nut should then be placed on the soil and covered lightly with the rest of it. In districts where the young plants are subject to attack by the coconut beetle, the soil should be forked, the surface levelled, and the nut planted so as to leave a part of the neck of the shoot exposed. When removing the sprouted nut from the nursery bed care must be taken not to injure the roots, and any that may be injured should be cut off before planting.

TREATMENT AFTER PLANTING.

Care must be taken that the nuts are kept covered with earth, as they tend to grow out of the soil in time. When this occurs the base of the palm should be moulded up so as to again cover the roots. The soil round the palms must be kept clean and free from weeds, and should be dressed about once a year with manure and ashes. Catch crops, such as cassava, cotton, maize, sweet potatoes, etc., may be planted between the trees, but not close to them.

In about five to six years' time the palms will begin to produce fruit, but they will not bear well until the seventh to twelfth year after planting.

Carefully planted and cultivated coconut palms, under favourable conditions in British Guiana, should yield average crops of from eighty to one hundred nuts per tree per annum.

FURTHER CONSIDERATIONS.

In these instructions recommendations are made that coconuts should be planted at least 2½ rods apart on rich soil and 2 rods apart on poorer soils. These distances allow of 46 and 75 trees per acre being planted respectively. When making this recommendation the Board did not take into its consideration the planting of lands with coconuts which were already laid out for other cultivations, but assumed that the lands would be new lands and hence could be drained or laid out in beds to suit the conditions of planting.

At present lands that have been laid out for sugar-cane or other cultivations into beds three roods wide are being largely used for planting coconuts. At first sight it would appear

simple in the extreme to set out coconut plants either 3, 2½ or 2 roods apart in rows along the middle of the beds. But the question arises as to how many coconut palms can be thus planted on an area of one acre. The numbers are 33, 40 and 50 respectively.

It is not safe to assume that on the narrower system of planting average annual yields of more than 60 saleable coconuts per tree will be obtained. On the widest system an average yield of 80 saleable coconuts might perhaps be safely calculated upon. Assuming that the value of a coconut after picking is eight-tenths of a cent, the value in round figures of a year's produce of the beds planted with trees 2 roods apart would be about $24 per annum, when planted with 2½ roods $22, and when planted at 3 roods $21.

It is thus clearly desirable to make a better use of 3 rood beds. As a general rule in fairly well made 3 rood beds after abandonment from sugar-cane cultivation the better drained parts will be at distances of from half a rood to a rood from the trenches. The middle parts of the beds are apt to become somewhat lower than the sides and hence are less satisfactorily drained.

The problem is how to set out the coconuts on these 3 rood beds so as to ensure the highest monetary yield per acre without overcrowding the trees. This has recently received some attention from the Department of Science and Agriculture and from that of Lands and Mines and the following plans have been prepared.

EXPLANATION OF PLANS.

Plan *A* is for planting coconuts in good, fertile, loamy soils. The rows of palms are laid out at distances of ¾ of a rood from the middle line of each field drain in such a manner that on any bed the trees are not situated opposite but diagonally to one another. This is known as planting in quincunx. The plants are set out 3 roods apart along the lines. Each tree, therefore, is three roods from the nearest tree in the same row and three roods apart from the corresponding trees in the nearest bed. The trees themselves are 2.12 roods or about 26 feet apart in any direction from the nearest ones. There would be sixty-three trees to the acre in this mode of planting and the value of the coconuts obtained per acre per annum should be about $35.

If the land is of a poor nature, having either a light sandy soil or a heavy clay soil, the palms in the row should be set out in quincunx as shown in Plan *A*, but 2½ roods apart as shown in plan *B*. This will allow of eighty trees per acre, each tree being nearly 2 roods, or 24 feet, apart from its nearest neighbour. Taking the yield of the trees at 60 saleable coconuts per acre the value of the produce should be $37 per acre.

Planting in the modes here suggested when it is desired to get better drainage than that of the beds as originally laid out will enable this to be done by running a shallow drain, a so-called "tracker" or "drill" along the middle of each bed. The clear space towards the middle portion of the beds will also allow of the planting of such a product as creole or robusta coffee or of ground provisions during the first three or four years growth of the coconut palms.

Where the land has been laid out in beds narrower than 3 roods the only planting that can be recommended is in rows along the middle of the beds, the palms being set out at either 3, 2½ or 2 roods apart according to the nature of the land. With 2 rood beds this will allow of 50, 60 or 75 trees per acre respectively, and the value of their produce when in full bearing should be from $32 to $36 per acre per annum.

The Sorrel (Roselle) and its Enemies.

The most serious insect enemy of the roselle is the root-knot nematode (*Heterodera radicicola*). A cheap and effective remedy for this pest has not yet been found and infested lands should not be planted with the roselle. This pest has not yet been reported from the Philippines. The cotton stainer (*Dysdercus suturells*) has made its appearance on the ripening calyces of the plant both in Florida and the Philippines, but seems to be of minor importance. Aphids (*Aphis* spp.) that sometimes attack the young plants are readily controlled by the application of tobacco dust. Two scale insects (*Cocus hesperidum* and *Hemichionaspis aspidistræ*) have been recorded on the roselle, also a mealy bug (*Pseudococcus* sp.) neither, however, as serious pests.

—"Philippine Agricultural Review," March, 1912.

Science as a School Subject in British Guiana.

By the Editor.

II.

Having in our previous article endeavoured to trace the introduction of Science as a school subject and to show that it differs radically in its importance as a medium of education and in its method from the other subjects in the curriculum, we may proceed to consider the topic of examinations and their application to Science. From what we have already written it will be easily understood that as soon as Science was admitted into the school course it became the subject of examination, and that as to the scholastic mind there is only one test of work that examination was a written one. A printed paper of questions was given out, and the boys sat at their desks and wrote the answers to them. Such questions in many cases, it is true, dealt with experiments, descriptions and details of which were required. In Chemistry, particularly, the preparation of many substances, elementary or otherwise, was asked for, and, we must admit, in many cases given satisfactorily. This method of the written examination pure and simple is still in vogue here and there : it is possible as a matter of fact to pass the London Matriculation Examination in Chemistry without submitting to a practical test at all—a state of things which is, to say the least of it, surprising. Better counsels prevail as a rule, however, and a practical examination—of a sort—is usually an adjunct to the Science examination of our time. Unfortunately the experimental part is still quite secondary and the written paper holds pride of place—and carries most marks !

PRACTICE FIRST.

Anyone who has followed the arguments we brought forward in our first article will understand that to our mind this procedure is wrong. Holding the views we do, we claim that the practical examination is all-important and that the written paper has no object or meaning until the student is sufficiently advanced to deal with the history of his subject or to discuss the theory of it. The description of preparations has always seemed to us particularly futile. If an examiner asks a boy "Can you write Latin verse ?" "Translate 'Everybody's doing

it' into French?" or "What was the year in which King John lost his things in the Wash?", the answer can best be given in writing, and from the written reply the examiner can make a real estimate of the boy's capacity; but if the question is put "How would you determine the composition of water experimentally?" or "How would you prepare caustic soda?" a written answer, however technically correct, gives very little indication of the boy's ability to perform the operation involved. To revert to our cricket analogy once more: we can imagine the query put "How would you bowl a slow leg-break?" and a class of boys required to answer it. We could be certain that the best answer would be given by the boy of a literary turn of mind who had read a description in the "Boy's Own Paper" and that probably the worst would be submitted by the only boy in the form who could send down a good ball of that kind. Science, we repeat, is founded on experiment, and to study Science boys must begin with experiment; and we complain that the written examination, especially for junior Forms, merely encourages the youth with a literary gift and absolutely fails to recognise or reward the youngster who can do things but cannot write about them. Fortunately for England, at any rate, the instinct to do things is born in every boy, and it is probably for this reason that the fallacy underlying, until quite recently, school Science and Science examinations was not exposed long before it was. In the tropics the inclination to physical activity is at a minimum, verbal memories are quick and retentive, and book work comes easily and is consequently popular. As we have already pointed out, the effect of Science properly taught is to develop manual skill, originality, enterprise and a delight in doing things; any rational examination in the subject should recognise this and be framed accordingly.

THE PRACTICAL "PRACTICAL EXAMINATION."

If then the practical part of a scientific examination is the real test of merit, surely it should be "practical" in the real sense of the word *i.e.*, it should have some relation to the conditions which govern the practice of that branch of science in ordinary life. Now no one would send a sample to the Government Laboratory for analysis with the stipulation that the work *must* be done within a specified time—two hours, let us say. Accuracy in results is what is required, not despatch. Why then should schoolboys be required to work out at least two problems in analysis or quantitative work

within a limited period—usually two, occasionally three hours? Boys have no monopoly of manipulative skill—those who know and like them best are the first to recognise their light-hearted carelessness and talent for breaking things—and even the best worker in a Form may make a slip at the critical point in an experiment and have to repeat the work *ab initio*. And in doing this he would be in good company. Do we not read of Dumas' classical investigations to determine the composition of water that out of fifty experiments begun only nineteen were brought to a definite conclusion; and that of those thus completed the majority occupied 24 hours each? How would Dumas have fared had he been working under modern examination conditions? Again, no chemist who valued his good name would stake his reputation on the result of one experiment only; he would take the mean of several. The practical examination in schools allows no time for this essential. All these points are drilled into a boy in the course of his scientific training; he is warned that he cannot weigh accurately in a hurry, that the precipitation of the second group by hydrogen sulphide must be done thoroughly and by a complicated process which involves much shaking and occupies a long time; yet in the yearly examination he has to throw all these instructions to the winds and hurry, hurry, hurry to get through the work set within the time-limit. Can it be wondered at that the average practical chemistry examination in schools partakes more of the nature of a guessing competition than what it should be, a sober scientific inquiry? All the little precautionary methods to ensure good results—the drying of powders, the careful cleaning of metals, the thoughtful devising of original experiments to confirm the findings of analysis—are all put out of court by the conditions imposed; yet they are the very points which would tell most heavily in a lad's favour if he had to apply for a post as assistant to any scientific man.

THE QUESTION OF BOTANY.

The same objections apply to examinations in Botany. The detailed description of a flower takes a very long time to do properly. The discovery of the finer points of structure in an unknown specimen requires close application and a considerable command of method and cannot be done hurriedly. The history of Botany will show that years and in many cases centuries elapsed before certain details in quite ordinary plants

were correctly elucidated. Why should a schoolboy be expected to do miracles of divination? Yet he is required to answer six questions, two at least of them involving practical work, within three hours. Of course, in the circumstances, experiments in the physiology of plants are out of the question; yet this part of the science grows daily in importance.

Another point. Colonial boys are examined by papers set in England by Englishmen who, except in the rarest cases, can have no first-hand knowledge of the conditions obtaining in any of the colonies and certainly cannot modify their questions to suit the peculiar circumstances of each. Yet the same paper is sent to schools in Australia, Ceylon, South Africa, Mauritius, Barbados, and British Guiana, and the same schedule is imposed upon teachers in all those places. With literary and mathematical subjects no hardship arises. Good Latin is good Latin whether it be written in Melbourne or Colombo, Natal, Bridgetown, or Carmichael street; French is standardised by the Academy of Paris and is not affected by latitude or climate, colour, race or nationality; the solution of a quadratic equation or an application of de Moivre's Theorem is the same whether done in China or Peru. With Science it is utterly different. The object of science teaching being to bring a boy to understand his environment, local conditions are all-important. The familiar things which a boy encounters every day of his life arė the very things which should form the subject of his earliest investigations. This principle is admitted, and is the basis upon which schedules, especially for preliminary examinations, are founded. And it leads to some very disconcerting results. Take water for instance. It is laid down in the schedule that various kinds of water shall be studied and amongst them are included 'hard water' and 'soft water'—two very familiar varieties of fresh water to the English boy. But 'hard water' is quite outside the experience of the youth of British Guiana. The only kinds of fresh water he knows anything about by practical experience are rain-water and surface-water—which latter may be "Lamaha," "trench," or "creek" water according to circumstances. From the point of view of education, these two varieties, though both 'soft water,' offer just as great facilities for good teaching as the English kinds; as a matter of principle they should be substituted for the hard and soft water of the schedule. So the intelligent teacher is in a quandary. He may manufacture artificial hard and soft water to satisfy

the schedule and coach his boys in a subject in which they can have no practical interest unless they emigrate to Barbados, or he may stick to principle and run the risk of seeing in the yearly report from England "the question on water was very poorly done on the whole, especially by the Junior Forms." Yet he may know in his heart that he has taught his class on thoroughly sound lines, explaining to them the vital differences between rain-water and surface-water, the virtues of the one and the dangers of the other, the sources of contamination and the methods of purification of both—things which they should know and ought to know, and which he is satisfied they do know.

ENGLISH EXAMINERS AND LOCAL QUESTIONS.

The state of things is even worse when English examiners set papers in such subjects as Agriculture. He would be a bold man (if an untravelled native of British Guiana, experienced agriculturist though he might be in his own country) who would pretend to examine students even in so near a colony as Barbados in a subject requiring such intimate knowledge of local conditions. What importance can be attached to results obtained from papers for colonials set in England by an Englishman on a schedule which stipulates—to quote only one point—for a knowledge of local weeds? It will be obvious that such results must have an entirely different value from those of an examination in Greek or Geometry.

We should not like it to be thought that scientific examiners in scientific subjects are unaware of, or indifferent to, the points we have brought forward. Quite the contrary. It is possible to some extent for a good examiner to judge from a written answer whether or not a boy has actually done what he is writing about. Year by year, too, some leaning towards a more rational system may be noticed, and on the whole considerable progress has been made within the last twenty years to escape from the trammels imposed by an inflexible scholastic tradition. But until practical work is properly recognised and some system of inspection by local men familiar with local conditions is instituted for the guidance of the English examiner, and until the written paper is wholly abolished for junior Forms, Science teachers will still have legitimate cause for complaint. Only last year the Cambridge examiner who set the Botany paper for the Upper Forms at Queen's College asked for an invigilator to inspect the

practical work done and forward a report, and extended the time for all practical examinations to three hours—two welcome innovations which showed that the right spirit was abroad. For junior Forms a personal inspection of the classes at work would afford a far more valuable criterion of the progress of the boys and the quality of the teaching than any answers to a written paper. The intelligence with which the boys set about their experiments, the neatness of their manipulation, their initiative and the extent to which they relied upon themselves instead of pestering the teacher for minute directions to be followed slavishly, would all be valuable indications of the effect of the teacher's method, just as at cricket the keenness of the boys, the excellence of their fielding, the spirit they show. and the way they "play the game" are sure tests not only of the standard of their cricket but also of the tone of the school.

(To be continued.)

Copra, the Next Boom.

"Copra, the next boom," has been the watchword of the tropical planters for two years now—ever since the famous rubber boom came and went. In fact for several years the far-seeing capitalists and estate owners in the Old World Tropics have been quietly shaping their plans to this end.

Millions of people have been consuming thousands of tons of coconut products without really knowing or appreciating just what they were eating: the time has now arrived when the world is interested in knowing more about coconut foods, and the belief in the wholesomeness thereof is becoming one of the best features of the question. Animal fats, oils, and tallows, some of which were of a questionable nature from the sanitarian's point of view, are now shown at a disadvantage in some respects when compared with the pure and germless vegetable butters and oils. This means more coconuts.

Sugar with plenty of capital is good; tobacco is occasionally very profitable; and rubber would be advisable in a droughtless typhoonless region: but coconuts are probably the surest, most generally dependable of the "gross culture" crops of the Tropics to-day. Golden opportunities are awaiting the investor here.

—The "Philippine Agricultural Review," May, 1912.

Sugar-Cane Experiments.

TRIALS WITH MOLASSES AS A SUGAR-CANE MANURE OR FERTILISER, AND WITH CHLORINATED LIME AS A SOIL AMELIORANT.

By J. B. Harrison, C.M.G., M.A., Director of Science and Agriculture and R. Ward, Agricultural Superintendent.

DURING recent years there have been many references to an alleged beneficial action of vacuum-pan molasses when applied to the soil of cane fields. Where satisfactory results have been reported as obtained, almost without exception these have been where modern scientific methods of control are not used in agricultural research so that some of the apparently beneficial results may have been due to differences in the fertility of the soil and not to the application of molasses. Several more or less scientific attempts at explaining the results obtained have followed these experiments.

In 1910 it was decided to make a careful examination into the effects of treating the soil of the Experimental Fields with molasses. The assistance of the Hon. R. G. Duncan was obtained and carefully devised comparative trials have been made during the crops of 1911 and of 1912.

In order that the results should be reliable 42 plots, each in duplicate, were employed. The yields of these plots had been determined in the crop of 1910, when it was found that the 42 half-plots which were to be treated with molasses gave 38,800 lbs. of produce, (canes and cane-tops) whilst the 42 half-plots not to be so treated gave 38,600 lbs. The average soil-conditions of the two series of plots on the area employed, approximately two acres, therefore appeared to be fairly uniform.

The trials enabled us to test the action of the molasses on plots with the following treatments :—

(*a*) Not manured ... ...(1891–1912).
(*b*) Manured with phosphates & potash ... ,,
(*c*) Manured with sulphate of ammonia only ,,
(*d*) Manured with phosphates, potash and sulphate of ammonia ... ... ,,

(*e*) Manured with phosphates, potash & nitrate of soda ... ...(1891–1912.

The molasses was applied to various groups of plots at the rates of 100, 200 and 300 gallons per acre respectively.

The molasses was analysed before application in order to ascertain its content of water, and to facilitate its uniform application to the cane-rows it was dissolved in water. When the molasses was applied the plots not receiving it were watered with water equal in amount to the total received by the corresponding molasses-treated plots.

The mean results of all the trials were as follows :—

	TONS OF CANE PER ACRE.		
	1911.	1912.	Mean 1911–1912.
Without molasses ...	14.5	27.4	20.9
With molasses ...	14.9	28.0	21.4

In order to measure the reliability of the above figures the yields of every pair of plots were calculated so as to ascertain the relation of the yields of the molasses-treated plots to those not so treated taken as 100. From the results obtained the "probable errors" of the trials were calculated. The results are :—

Mean yields of plots without molasses taken as 100.

With molasses 1911 ...	102.7 ± 3.3
" " 1912 ...	102.3 ± 2.1

The yields with the various manures used were as follows :—

	TONS OF CANES PER ACRE.			
	No Molasses.		*Molasses.*	
	1911.	1912.	1911.	1912.
No manure	7.3	21.3	6.0	17.7
Phosphates and potash ...	9.9	19.1	9.2	20.0
Sulphate of ammonia only	16.8	26.8	18.8	25.6
Phosphates, potash & sulphate of ammonia ...	17.1	29.4	17.1	29.1
Phosphates, potash & nitrate of soda ...	13.9	34.0	14.1	35.1

The results of the application of the molasses as calculated from returns of each series of plots—the mean return from the untreated plots of each series being taken as 100—are as follows:—

	1911.	1912.	1911–1912.
No manure	82.2	83.1	82.7
Phosphates and potash ...	92.9	104.7	98.8
Sulphate of ammonia only	111.9	95.9	103.9
Phosphates, potash & sulphate of ammonia ...	100.	99.2	99.6
Phosphates, potash and nitrate of soda ...	101.4	103.2	102.3

On the not-manured plots the application of molasses has been detrimental; on the plots manured with phosphates and potash and with phosphates, potash and sulphate of ammonia it has been without any effect, whilst on the plots manured with sulphate of ammonia only or with phosphates, potash and nitrate of soda some slight increase has occurred. But these increases are within the limits of the "possible error" of the trials as determined from this enquiry—5.6% and 6.8% respectively.

If the apparent beneficial influences noted in the trials were due to the application of the molasses, the rate of increase should be *pari passu* with the increment of the molasses used. The mean results are:—

Mean yield of plots without molassss taken as 100.

	No. of trials.	1911.	1912.	1911–1912.
No molasses	70	100	100	100
100 gallons molasses	42	101.3	98.4	99.9 $\pm$ 1.7
200 gallons molasses	28	96.3	106.8	101 6 $\pm$ 2.2
300 gallons molasses	28	110.8	97.8	104.3 $\pm$ 2.2

The slight increases which appear to have been due to the application of the molasses were in all probability produced by its nitrogenous constituents.

TRIALS WITH CHLORINATED LIME.

The increased yields obtained in some places by the application of molasses have been explained by its alleged favourable influence on the bacteria of the soil. Closely connected with that allegation is the proposal to destroy or to lessen certain soil-organisms by the use of sterilising agents.

On the stiff clay soil of the Experimental Fields it is practically impossible to apply such volatile substances as toluene, carbon bisulphide, etc. We therefore decided to try the effects of partially sterilising the soil by treating it with a solution of chlorinated lime or bleaching powder of such strength that 150 lbs. of the powder, equivalent to 50 lbs. of active chlorine, were applied per acre. To eliminate from the results any favourable action that might be due to the lime of the chlorinated lime, we applied to the plots not receiving it lime in quantity equivalent to that applied in the bleaching powder. The bleaching powder was dissolved in water to form a solution of the desired strength, whilst an equivalent amount of slaked lime was dissolved in an equal volume of water. The plots which it was desired to partially sterilize were watered with the solution of bleaching powder whilst the duplicate plots were watered with the solution of lime. The amount of chlorine as chlorides normally present in the rain which falls on the Experimental Fields is so high in proportion to that in the applications of bleaching powder that it was not considered necessary to apply chlorides to the duplicate plots.

The trials were arranged so that on 28 duplicated plots the yields of the whole of their areas and of the inner rows were separately ascertained with the object that results possibly due to interfering factors on the outer rows could be eliminated from the calculations. The results thus obtained were :—

	TONS OF CANES PER ACRE.	
	Not sterilized.	*Partially sterilized.*
Whole plots ...	22.9	23.0
Inner rows only ...	21.3	22.1

The yields recorded from each of the 28 duplicated plots were calculated to compare the results on the partially sterilized plots with those of the non-sterilized, the latter being taken as 100. From the figures obtained the "probable errors" of the trials were calculated. The results thus obtained are :—

	TONS OF CANE PER ACRE.	
	Not sterilized.	*Partially sterilized.*
Whole plots ...	100	103.2 $\pm$ 2.4
Inner rows only ...	100	105.5 $\pm$ 2.3

There is thus no indication that the partial sterilization by chlorinated lime exerted anything more than a slight effect on the productiveness of this very heavy clay-soil under cultivation with sugar-cane.

The Diagnosis of true Hevea brasiliensis.

By F. A. Stockdale. M.A., F.L.S.

Mr. F. A. Stockdale, till lately Assistant Director of Science and Agriculture, made a careful investigation of the varieties of rubber trees cultivated on certain estates in British Guiana; and the following notes on the varieties of *Hevea brasiliensis* and of *H. confusa* have considerable interest in view of the doubts that have hitherto surrounded the subject.

"The leaves of *H. brasiliensis* vary considerably in shape. Some trees possess leaves that are typically lanceolate whilst others are much broader. Often trees in favoured situations making very vigorous growth produce very large leaves which are broader in comparison with their length than are the typical leaves. Not infrequently two or more types of leaves are to be found on the same trees. The under-surface of *H. brasiliensis* leaves in the young stage are either slightly purplish or greyish-purple in colour, but this colour disappears as the leaves become older. The petiolar apical glands of *H. brasiliensis* are either three or four in number but sometimes two are to be found. When two only are present, they are generally close together and not widely separated as in *H. confusa* and other indigenous species. The very young leaves of *H. brasiliensis* hang vertically downwards, unless distorted by wind.

BARK VARIATIONS IN H. BRASILIENSIS.

"The bark of *H. brasiliensis* varies. As recorded in 1910, at least two (distinguished by external appearances) types of barks exist in 12 year old trees of *H. brasiliensis* growing in the colony—the one a corky bark showing longitudinal markings and the other a perfectly smooth greyish-white bark showing no warts or markings. These barks on being tapped show marked differences—the former being thick and of a reddish-brown colour when freshly cut and yielding a good return of latex, while the latter is thin, of a greenish-white colour when cut, and yields little or no latex. It was then also observed that the trees showing these differences in barks also exhibited differences in habit of growth, and it was recommended to cut out the smooth-barked kind as it was a very poor latex yielder and might produce seeds or cross-

fertilize with the better, rougher, longitudinally-marked kind. Subsequent examination of younger plants growing under varying conditions of soil and climate revealed that there was another type of *Hevea brasiliensis* that differed in the external appearance of the bark. This kind showed a sparsely warted or prickly appearance. These small "warts" or "prickles" were near the ground-level of the stem, often arranged more or less longitudinally, and existed on the stems to a height of about three feet above the level of the ground. Above this the stems were smooth. The yield of the latex from such a kind of *H. brasiliensis* could not be ascertained as the trees had not reached tappable size, but it was noticed that generally this type was not quite as vigorous in its growth as was the rough longitudinally-marked type.

CEYLON TYPES.

"Mr. Kelway Bamber, of Ceylon, in a paper read at the Rubber Exhibition, London, 1911, recorded that in Ceylon there were at least three types of *H. brasiliensis* trees differing in their barks. Two of these, he stated, yielded latex satisfactorily, while the third—which had a thin, smooth, greyish-coloured bark—gave practically no latex. When tapping experiments were commenced in June last, at the Issorora Experiment Station, North Western District, (B.G.) careful notes were made of the different kinds of barks found. At least three could be distinguished by external appearances, but it is possible that these may again be subdivided into other groups on account of internal differences. It was noticed that the corky, longitudinally-marked variety always possessed a thicker bark than the other sorts, was more easy to tap and seemed to yield relatively the largest returns of latex. This is the kind that would, from our present knowledge, be recommended for planting purposes if seed selection were possible."

CONFUSA HYBRIDS.

With regard to certain plants raised from seeds obtained from Trinidad, Mr. Stockdale reports :—

"There is no doubt that these plants have been raised from seeds obtained from hybrid *brasiliensis* and *confusa* plants. There were quite a number of different forms of leaves and barks, but I was able to pick out, even in my hurried inspection, several plants that were typically *confusa*.

The barks of such plants are darker in colour and are covered with warts placed very close together. The leaflets are of a lighter green in colour than *brasiliensis*, glossy, very coriaceous in texture, broader nearer the shoulder than across the middle of the blade, venation closer than in *brasiliensis*. The petiolar glands are generally two in number set far apart and are of a different shape than are the glands of *brasiliensis*. The petioles are generally purple or greenish purple in colour. The latex of *confusa* is always yellow."

Specimens from a large number of seedling plants in the Nursery of a plantation in the colony, which judged by the above-mentioned characteristics, were considered by the technical officers of the Department not to be typical *Hevea brasiliensis* but probably hybrids of *H. confusa* and *H. brasiliensis*, were recently forwarded to the authorities of the Royal Botanic Gardens, Kew, for critical and authoritative examination. The following are extracts from the report of the Assistant Director of Kew (Mr. A. W. Hill, M.A., F.L.S.) :—

" We find ourselves in complete agreement with Mr. Stockdale's conclusions . . . . . those grown in the nursery at Pln. . . . . . (Specimen No. 8,886) are either from examples of *H. confusa* or hybrids between *H. confusa* and *H. brasiliensis*."

Where Scientific Education should Begin.

Science, like charity, begins at home. Our Education Department could not do a wiser thing than to popularize the technical geology of the State in a school book and put such a volume into the hands of every scholar. It would exert a vast influence.

—"Science," October 18, 1912.

Why a Root?

In its habits of sprouting the ordinary yam closely resembles the sweet potato, which also is not a tuber but a root. The sprouts which from their uncommon origin are called adventitious, may arise from any poinc on the surface of the root, though the tendency is confined largely to the basal half. In this connection it may be remarked that the cassava, which also stores up starch in a true root, cannot be induced to send out sprouts from even the basal end of the root.

—"Phillipine Agricultural Review," February, 1912.

The Flour Moth and its Control.

By L. D. Cleare, Jnr.

As the result of a recent enquiry in connexion with the control of the Flour Moth the bonds of several large importers of flour in Georgetown were visited. The moth was found to be present in several buildings and seemed especially partial to oats. As it threatens to become a pest the following article suggesting methods of control has been prepared. Of these by far the best and most effective is that with Hydrocyanic acid gas; and where possible it should be employed. As it requires *careful attention to details*, the method is given in full.

The exact species to which the Georgetown "Flour Moth" belongs is still a matter of doubt. The adult seems to be near, but not identical with, the "Mediterranean Flour Moth" (*Ephestra kuehniella*) but the pupa resembles closely that of the Indian Meal Moth (*Plodia interpunctella*). The methods of control here suggested are, however, valid for all the varieties.

Cleanliness undoubtedly does much towards preventing the introduction of the Flour Moth as well as restraining its increase where it has already gained a foothold.

HISTORY AND DISTRIBUTION.

In the year 1877 when the moth was discovered in a flour mill in Germany, this insect was practically unknown. It was next discovered in Belgium and Holland, and in 1886 appeared in England. Three years later it made its appearance in Canada. In 1892 it was reported as injurious in mills in California and in 1895 in New York and Pennsylvania.

Until 1892 this insect caused very little trouble in the United States but it is now aptly called "the scourge of the flour mill" and "winged grey plague." At first its progress was slow, but in a few years it had become recognised as the most serious pest in many States. After 1904 it greatly increased until in 1910 it was attracting more attention than any other insect that ever infested mills or other buildings where cereals are stored. At the present time it is known to occur in practically all the principal milling centres, and in most States from the Atlantic to the Pacific and from Canada to Mexico

Previous to the Canadian invasion this moth was generally believed to have reached Europe from America but in reality it was not recognised there until 1889. Danysz mentions an outbreak in Constantinople in 1872 and presents evidence that it was probably known in Europe as early as 1840. This insect also occurs in Chile and Australia. In the latter country it seems to do very little damage, thanks to the parasites which control it. These are referred to more fully below.

CONTROL BY HYDROCYANIC-ACID GAS.

The use of hydrocyanic-acid gas in mills and other large enclosures where grain, flour and similar products are stored was first suggested by the late Prof. W. G. Johnson in an article in *The American Miller* for March, 1898, in connection with a large mill in North Carolina that was overrun with cockroaches.

The first test of this method was probably that made by Dr. F. H. Chittenden and Mr. F. C. Pratt on March 5, 1898, when they fumigated a quantity of dried grain infested with the rice weevil (*Calandra oryza* L.) and a leguminous seed affected by a Bruchus or seed weevil.

During 1899 mills were fumigated in Pennsylvania and Ohio under the direction of Professor Johnson with satisfactory results, and in later years both by Professor Johnson and Professor Washburn.

ARGUMENTS IN FAVOUR OF HYDROCYANIC-ACID GAS.

The special properties of hydrocyanic acid-gas and some of the advantages it possessess as a fumigant for buildings infested with insects may be briefly summarized as follows :—

1. It is generated without fire.
2. It is practically non-inflammable and non-explosive when generated according to methods now in use.
3. It does not injure grain or manufactured products, machinery, furniture or equipment of any kind.
4. It leaves no odour or residue after fumigation.
5. It is lighter than air and has considerable penetrating power, quickly permeating all cracks and crevices in which pests hide.

6. When generated in air-tight inclosures it creates a positively deadly atmosphere and thus destroys most stages of the Flour Moth and some other insects. *It is, however, still more deadly to man and other mammals*, including domestic animals, rats, mice and other vermin.

7. *It is the most deadly poison in common use*, which fact when fully recognised prevents human beings from running unnecessary risks of exposure to its deadly fumes.

8. The process is comparatively inexpensive when buildings can be made nearly gastight, especially when complete exposure of from 24 to 36 hours can be obtained.

9. Fumigation can be carried out in the daytime or at night.

10. It affords insurance companies and others all the protection possible under such conditions.

HOW THE GAS IS MADE.

The chemicals used is generating hydrocyanic-acid gas, are (1) fused potassium cyanide, (2) sulphuric acid and water. As potassium cyanide and sulphuric acid are both poisonous and dangerous to handle it is advisable to have a person of some experience to supervise the operation.

Potassium cyanide—is a white crystalline salt which rapidly decomposes in a moist atmosphere giving off an odour of hydrocyanic, or "prussic," acid. It is readily soluble in water and *is extremely poisonous*. The cyanide should be of high grade, if possible guaranteed 98–99 per cent., which is practically chemically pure.

Sulphuric acid—the chemical used in liberating the gas is known commercially as oil of vitriol or "vitriol," and is a dense oily-looking fluid. It has a powerful action, being corrosive to both animal and vegetable substances. The best grade of commercial sulphuric acid, with a specific gravity of at least 1.83 should be used.

Hydrocyanic acid gas—the gas liberated by combining potassium cyanide and sulphuric acid *is one of the most deadly*

poisons known to science and for this reason *the greatest care should be taken when fumigating buildings.*

As the success of fumigation greatly depends upon the purity of the chemicals used every effort should be made to obtain good materials.

COMBINING THE CHEMICALS.

In combining the chemicals first measure the water in a glass beaker marked in ounces. Pour into generator. Next add the acid, measured in the same beaker, which is gently and slowly poured into the water to avoid splashing and boiling. The acid should never be placed in the generator first, as spattering is almost certain to follow. When the acid is added to the water in the jar an evolution of vapour sometimes arises. As soon as the potassium cyanide is dropped into the diluted acid a bubbling takes place and hydrocyanic acid-gas is given off. It is a colourless gas and has a characteristic odour. *These fumes, if inhaled, are almost certain to prove fatal.*

The Vessel.—Various kinds of vessels can be used for the acid and water. Usually an ordinary earthen jar serves the purpose admirably. In some cases a wooden pail or tub can be used with advantage. Under no circumstances should tin or iron vessels of any kind be used, as the acid would quickly ruin them.

The Residue.—After a charge of gas has been liberated there will be a residue left in the jar. Immediately after the building has been ventilated for the desired length of time the contents of the jar should be buried in a hole specially prepared for it.

ESTIMATING THE QUANTITY OF THE CHEMICALS.

To determine the amount of chemicals to be used in fumigating, the cubic contents of the building must be accurately calculated. In buildings where more than one story is to be treated the cubic contents of each floor should be worked out separately and a table prepared for the guidance of operators indicating the number of generators and the amount of chemicals to be distributed on each floor. Inside measurements should be taken and the height of each story should be carefully measured as well as the floor space. Recent work in this connection has demonstrated that for

ordinary well-constructed buildings good results may be expected by the use of 10 ounces of potassium cyanide and corresponding amounts of other ingredients to 1,000 cubic feet of air space. Wherever a building cannot be made absolutely air-tight (and this must be left to the judgment of the operator) additional quantities are necessary. The amount of chemicals to be used for a building vary according to the tightness of the parts so that no uniform strength can be laid down.

NECESSARY PREPARATIONS.

The building should be made practically gas-tight by closing up all cracks and external openings. This can best be done by pasting strips of ordinary brown paper over the cracks. The doors and windows should also be treated in this manner.

There should be no lights in the building while it is filled with gas. Although the gas is not explosive under ordinary conditions it is best to be on the safe side.

All boxes, barrels, etc., should be opened where possible, and all unnecessary material should be removed and burnt before the chemicals are placed in position. A door and several windows should be so arranged as to allow of their being opened from the outside after the fumigation is finished to permit the escape of the gas and the thorough ventilation of the building.

A special watchman should be detailed to guard the premises while the fumigation is being carried out.

In buildings where several rooms or floors are to be fumigated at the same time, each room or floor should be shut off from the others as much as possible. In doing this care should be taken not to blockade the stairway. The operator must be able to escape easily and rapidly when the gas is generated.

Signs should be placed on the doors of the building that is being fumigated warning persons of the danger, *e.g.*, DANGER. HYDROCYANIC ACID GAS. POISON. Neighbours of course should be warned of the danger of the operation.

Tins and other receptacles containing the chemicals should be plainly labelled POISON and the danger of careless handling should be carefully explained to each person assisting in the operation.

"STRINGING" THE BUILDING.

While "stringing" is not absolutely necessary it is always best to go to the extra trouble and be on the safe side. After the generators are fixed in place, strings are arranged so as to hang directly over each of them and are passed through screw-eyes in the ceiling to the keyhole of the room to be treated. The screw-eyes should be driven home and a cord of good quality used. The bags containing the cyanide are fastened to the free ends over the generators, after the water and acid have been placed in them, care being taken that they are firmly attached to prevent them dropping into the generators before required. The cords should be arranged if possible to allow all the bags to be lowered into the jars in one motion.

POSSIBLE DANGERS.

As soon us the bags containing the cyanide are dropped into the generators the operator should pass on to the next generator as quickly as possible. It is not safe to linger under any circumstances or return in case of an omission. *Any carelessness on the part of the operator may mean loss of life.*

The residue found in the generators after fumigation should not be left in them, but immediately buried and the generators thoroughly cleaned.

The gas is apt to tarnish—though not permanently—brass and nickel and for this reason such fittings should be removed if convenient.

Liquid and moist food materials such as milk and meats are apt to absorb the gas, and should therefore be removed.

SUMMARY OF OPERATIONS AND PRECAUTIONS.

1. Use pure chemicals, generators as described, and paper bags of good quality.

2. Measure building carefully for calculation of amount of chemicals to be used. If more than one floor is to be fumigated measure each separately.

3. Make building as nearly gas-tight as possible.

4. Make first fumigation with 10 ounces to 1,000 cubic feet of space, unless building is unusually loose, in which case more must be used.

5. Repeat fumigation at the end of three or four weeks if moths begin to fly.

6. Operators should be intelligent and reliable.

7. Preparations should be made for the prompt ventilation from outside, after fumigation.

8. Danger signs should be placed on doors, etc., and a special watchman stationed outside until fumigation is completed.

9. If more than one flat is being fumigated, begin operations in the upper floor and pass quickly downwards.

10. Fumigate preferably on a Saturday afternoon so that the building need not be opened for at least 24 to 36 hours.

11. Always pour in water first, then acid and lastly cyanide. Never reverse the order.

12. The operator should never return to the building after the fumes begin to issue.

13. Everyone connected with the fumigation should be made to understand the dangers and the possible results from careless handling.

FUMIGATION WITH CARBON BISULPHIDE.

Carbon bisulphide has been used for a number of years in fumigating buildings but recent experience has shown that it has many disadvantages. The vapour given off by this chemical is heavier than air and consequently only acts on the lower parts of the building. When mixed with air it becomes inflammable and highly explosive and is therefore extremely dangerous when used in wooden buildings. For this reason most insurance companies object to its use. As with hydrocyanic-acid gas the amount of chemical to be used depends upon the size and tightness of the building. Where the building is ordinarily tight and the attack not very severe one pound of carbon bisulphide is sufficient for every thousand cubic feet of air space. If the building is somewhat open and badly infested the amount should be doubled.

Methods of Application.—The most effective manner of fumigating with carbon bisulphide consists in simply pouring the liquid into shallow dishes or pans and distributing them about the building. These pans should be placed as high as possible. In placing the dishes the operator should start in the lowest storey and work upwards. When the carbon bisulphide has been thoroughly distributed the building should be closed for about 36 hours.

DANGERS.

Owing to the explosive nature of the gas no artificial lights of any kind should be allowed in the building. Even electric lights should not be used. For this reason the work can only be done in daylight. No smoking should be allowed near the building that is being fumigated.

CONTROL BY NATURAL ENEMIES.

On account of the open nature of the buildings existing in this colony fumigation can seldom be recommended as the best method of control. Some buildings visited in Georgetown were noticed to have latticed sides while in others none of the joins in the walls seemed to fit properly. In buildings like these fumigation is out of the question, as it would cost a considerable sum to make them anything like gas-tight, and, in addition, the sealing up would have to be redone every time a fresh fumigation was necessary. It would appear probable therefore that the most effective method of control of the Flour Moth in Georgetown will be by means of the natural enemies of the insect.

In New South Wales* these insects are parasitised by two hymenoptera, *Amorphota ephestia*, Cam., and *Bracon* (*Hadrobracon*) *hebetor*, Say, which seem to keep them in control to a large extent. Some of these parasites might be imported and distributed among the flour stores. If this method were to prove successful it would be by far the cheapest and would need practically no attention after a few months. Similar means for the control of insect pests have been already employed with success in the United States and Hawaii.

If the idea of importing parasites is taken up, importers should first correspond with this Department when they will be given all the assistance possible. With regard to fumigation it would also be advisable to let at least the first operation be carried out under the supervision of an officer of this Department.

In preparing this article much information has been taken from Circular No. 112 of the United States Department of Agriculture as well as from Professor W. G. Johnson's "Fumigation Methods."

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* "Parasitic Enemies of the Mediterranean Flour Moth," by W. W. Froggatt, F.L.S.—Agricultural Gazette of N.S.W., 2nd April, 1912.

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on the 6th January, 1913, at which His Excellency the Governor, Sir Walter Egerton, K.C.M.G., presided. There were in attendance Prof. J. B. Harrison, C.M.G. (Chairman), A. Leechman, (Acting Deputy Chairman), the Hons. Dr. J. E. Godfrey and J. Downer, and Messrs. J. Wood Davis, F. Fowler, C. P. Gaskin, S. H. Bayley, J. F. Waby, E. S. Christiani (Secretary) and others.

The acceptance of the position of honorary member by Sir Frederic Hodgson, K.C.M.G., and the resignation of the post of Deputy Chairman by Mr. F. A. Stockdale on his promotion to Mauritius were announced.

Dr. Godfrey proposed a vote of thanks to Mr. Stockdale recording their approval of his services during the period he had been a member of the Board. Mr. Stockdale, he said, for the very short time he had been in the colony, had proved his worth to everyone. He was of the opinion that the Board should record in the minutes their appreciation of Mr. Stockdale's services to the colony and particularly to the Department of Science and Agriculture, and that a copy of the resolution should be sent to Mr. Stockdale.

Mr. Gaskin seconded.

His Excellency, in putting the motion to the vote, said that in the short experience he had of Mr. Stockdale's services he fully recognised his great value to the colony. It was with the utmost regret that he received the telegram from the Secretary of State offering Mr. Stockdale the appointment in Mauritius. He regarded it as very complimentary to both Mr. Stockdale and this colony that he should have been chosen as the first Director of Agriculture for the important colony of Mauritius.

The motion was carried.

COCONUTS.

His Excellency, in connection with the plans for the planting of coconuts, recalled that it had been determined to provide an Ordinance imposing on every cultivator certain responsibilities,

among them that he should not be permitted to keep on his cultivation dead trees, or rubbish or anything which would foster insects. The enactment of that Ordinance would enable the Department of Science and Agriculture to see that all plantations were properly kept and were not a danger to their neighbours. The draft Ordinance had been prepared, but the passing of it had been delayed pending the return of Mr. Nunan to the colony.

Professor Harrison said Mr. Stockdale and himself had considered the question of planting coconuts very fully and carefully just before he left the colony. The problem was to plant the coconuts far enough apart to ensure their thriving well and at the same time to get enough palms in an acre to yield a decent profit. The aid of Mr. Fowler was enlisted and two plans had been drawn up and these would be published in the Journal of the Board.

His Excellency approved of the scheme.

Formal motions were passed placing the control of the D'Urban Park in the hands of the Board and approving the regulations in connection therewith.

THE AGRICULTURAL SCHOOL SITE.

His Excellency, reporting on the progress made concerning the provision of the site for the Agricultural School, said he did not think it advisable to establish the school close to the Onderneeming Reformatory as respectable parents might object to send their children to a place which might be mistaken for the Reformatory School close by. The subject was considered by the Executive Council, which confirmed his opinion. He thought that it ought to be placed somewhere on the right bank of the Demerara River to which access could be gained by land from Georgetown. It was one of his hopes that they would be able to re-open the road used in the time of the Dutch—or at least a part of it—enough to give an opening to the school by land as well as by water. He promised to look into the decision on the matter which was come to by the Combined Court.

Professor Harrison stated that on the suggestion of His Excellency it had been decided to carry on certain coconut manurial experiments. The chief difficulty was to find a suitable area of coconuts uniformly planted, but Mr. Payne had

mentioned a property on the East Coast owned by the Government and leased by Mr. Chapman.

This plantation was approved of and on the suggestion of His Excellency it was finally decided to find out whether, in view of the lease, the estate could be utilised.

OIL PALM SEEDS FOR THE COLONY.

His Excellency reported that arrangements had been made for a consignment of seeds of the African Oil Palm (*Elaeis guineensis*) from Nigeria for experimental cultivation.

THE LIME INDUSTRY.

The Chairman, referring to a proposal to establish a small citrate factory at Onderneeming, said the estimated cost of working such a factory would be at least £400 and possibly £500 or £600, apart from the price of the limes.

His Excellency : What was suggested was a small factory to cost £100, and with sufficient limes to keep the fac-tory going all through the year.

Mr. Payne made mention of a small factory he had seen at Aurora but Mr. Bayley explained this was closed down about eighteen months ago because limes were not obtainable in paying quantities: the Chiarman added that the factory had been dismantled and brought to Georgetown.

His Excellency thought an accurate estimate of the number of limes that would be forthcoming to sell to the factory ought to be prepared.

It was finally resolved to inquire further into the subject.

RICE FOR DISTRIBUTION.

Professor Harrison stated that they had some 16,000 lbs. of paddy for distribution, for which he would be glad to receive applications.

Professor Harrison also reported that at the Stall in Georgetown they had sold 3,435 plants, at New Amsterdam 2,106, at at Pomeroon 1,670, at Morawhanna 1,262, and at Suddie 154 to the 30th November. Mr. Bayley had applications for more at Suddie ; and the returns showed a steady increase in the demand.

The Chairman next raised the question whether it was worth while to keep a small cultivation of Para rubber trees at the Bonasica station, at a cost of not less than $20 a month, *plus* the expense of the Agricultural Inspector's visits, or to sell the site with the rubber already planted. A promising plantation owned by the Consolidated Rubber and Balata Estates was only four or five miles distant at Aliki, and would serve excellently for observation on the growth of rubber and so on.

His Excellency said that all the rubber he had seen in the colony had been neglected at some time of its existence. If proper care was taken of it, it would grow in British Guiana on suitable lands just as well as anywhere else.

GERMINATION OF RUBBER SEEDS.

Professor Harrison displayed specimens of rubber obtained from four year old trees at Issorora Experimental Station North West District. He also stated that they had procured 119,000 plants from the imported rubber seeds. The germination worked out at about 70 per cent. For Ceylon seeds, guaranteed to give 75 per cent., it came out at 55 per cent.; and Singapore seeds ranged from 65 or 66 per cent. to about 80 per cent.

With regard to the live-stock, Professor Harrison stated that a sum of $900 for the importation of new animals had been inserted in the estimates.

The appointment of Inspectors under the Cattle (Improvement of Breed) Ordinance, 1910, was reported.

His Excellency remarked that the price fetched by the stock sent from the Settlement to the previous sale had not been profitable. The stock had been sold at an average rate of $19 per head, while inferior animals were bought at over $18 a head.

Professor Harrison reported that the Veterinary Committee had recommended that compensation be given to J. Naraine for certain animals destroyed as suffering from glanders. This procedure was in accordance with the views of His Excellency.

The Wild Birds' Committee reported that a licence to kill wild birds had been granted to Mr. Edgar Beckett, and permission to export wild birds skin had been given to the Curator

of the B.G. Museum; Messrs. Booker Bros., McConnell & Co., Ltd; the New Colonial Co., Ltd.; Messrs. Smith Bros. & Co., Ltd.; and Mr. S. B. Warren.

Professor Harrison said that the canes at the Experimental Fields had been cut during the year and 178,500 cuttings had been supplied to the estates of the colony.

The meeting then adjourned *sine die*.

The Oil Palm *(Elaeis guineensis)*.

The palm-oil trade of tropical West Africa is now entering upon a new era of production due to improved methods in extraction. The price per ton of ordinary grade palm oil is about P300 delivered in the ports of Europe. This gives a profit of about 100 per cent. to the oil merchant and this means that with the new machines for cracking the nuts and extracting the oil there will be a rather rapid increase in the profit percentages of the business, if not in the production itself.

It is said the hinterland of Liberia contains a practically unlimited amount of the oil palm but on account of the transportation difficulties the project has, thus far, remained undeveloped.

Recently a few attempts have been made to cultivate this palm in the river valleys of the Gulf of Guinea colonies and even in East Africa but it seems unwise to plant valuable land with a crop which needs only a few railways laid down into the hinterland of practically any country from Sierra Leone to the Kongo in order to bring the output up to a figure which will materially reduce the price. The output of palm oil in British West African Colonies alone now amounts to some 60 million litres, valued at not less than 11 million pesos; while the yearly export of palm kernels is some 226,000 tons valued at over 32 millions pesos. These figures probably represent about one-half of the total output of these two commodities.

The point of all this is that coconut oil has a very serious rival, but because of the objectionable acids and other substances in the oil of the West African palm (*Elaeis guineensis*) it is probable coconut oil will long continue as the more valuable product, at least in the line of human food substances.

Both at the Singalong experiment station and in the Botanic Gardens of Manila, this palm has made a very vigorous growth and has fruited apparently as heavily as the descriptions of the palm in its wild state would indicate to be the normal yield.

—"Philippine Agricultural Review," June, 1912.

Board of Agriculture.

SALE OF LIVE STOCK.

THE Annual Sale of Live Stock, under the direction of the Board of Agriculture, was held at Eve Leary on Wednesday. January 15th. The weather was cold and wet, but nevertheless the attendance was satisfactory, the bidding keen and the prices encouraging. His Excellency the Governor visited the sale and took much interest in the proceedings, while the Director of Science and Agriculture and most of the members and officers of the Board were present.

A feature of the sale was the number of bulls offered. They were mostly cross-bred animals with Shorthorn or Holstein blood predominating. The best price obtained was $89; then $84, $62 and $60. A half-bred Zebu bull made $70.

Of the similarly-bred heifers, an 18 months old animal by a half-bred Zebu bull out of a Barbadian cow made $31; the others $29, $28, $23, $22 and $20.

The buffaloes from Onderneeming were as usual in considerable demand, the bulls—from 16 to 18 months old—bringing $45 to $39 and the heifers $40 and $30.

A Berkshire-Yorkshire Boar made $24 and two lots of sheep—5 each with ram—about $5 a head.

The total realized by the sale was $1,283.

The Possibilities of 'Banana Coffee.'

Although new foods and drinks usually have a long "probation period" in coming into popular favor, it is probable that if banana coffee could be properly advertised and handled by reliable firms, there would be no question about that article "taking" at once. It is made by partially roasting half-ripe fruits of some type like the plantains, and then grinding to the desired fineness. The aroma from "coffee" made this way is as delightful as the beverage itself.

—"Philippine Agricultural Review," March, 1912.

West Bank Agricultural Show.

THE Ninth Annual Agricultural and Industrial Show of the West Bank Farmers' Association was held at La Grange on the 13th November, 1912, and was favoured with excellent weather. There were present at the opening His Excellency Sir Walter Egerton (K.C.M.G.), who was attended by his Private Secretary (Captain Napier), the Director of Science and Agriculture (Professor J. B. Harrison, C.M.G.,) the Chairman of the Local Government Board, (the Hon. J. E. Godfrey), Mr. and Mrs. Wieting, the acting Assistant Director (Mr. A. Leechman), the acting Government Botanist (Mr. J. F. Waby), and others. The Militia Band under Lieutenant Carroll helped greatly to enliven the proceedings. The judging was in the hands of Messrs. Augustus, Hunte, Greeves and Christiani, and the Superintendent of Model Gardens (Mr. D. V. Jacobs) was also present.

Mr. Waby, in his official report on the show, states that the exhibits were all arranged in the same manner as on previous occasions but the various divisions were rather less crowded and one-fourth of the vegetable section was empty. The bottle section of the Economics was not conveniently arranged; in his opinion the exhibits might easily have occupied the empty space and would thus have been set off to much greater advantage.

THE DROUGHT AND ITS EFFECTS.

On account of the serious drought through which the colony had so recently passed and the shortness of the wet season which followed, it was generally feared that the show would prove a very poor one if not a distinct failure; and the excellent display agreeably surprised the reporter. Many articles, however, were short in number compared to previous shows and many were absent; but on the whole Mr. Waby thinks that the Association is to be congratulated on holding its own so well in spite of the adverse circumstances.

The exhibits were not confined to the district covered by the Association and consequently some of the prizes went to outsiders. The Chairman of the Association was glad to welcome articles from outside for the sake of making a good show but (as Mr. Waby points out) such a proceeding hinders the Board of Agriculture from knowing what the special district

is capable of and unduly handicaps the local Association: as prizes are taken away which should go to some of its own members.

In the fruits, especially Citrus fruits, although the quantities were a little less and most of the fruits smaller than usual; the quality was generally good. In the Tangerine oranges this was particularly so, none of the specimens exhibited being "floccy" and insipid. The Sweet Oranges, too, held their own; most of them being of the thin-skinned variety for which this district is noted.

Pine-apples were about the same as usual, the first prize being given to a basket with 3 fruits regular in form and size.

Sapodillas, Mangoes, Avocado Pears and the various apples were out of season, so the exhibits were poor.

Some of the Bananas—Jamaican and Dwarf (Cavendish)—were very good bunches, the others poor.

The Root vegetables were generally good, splendid samples of Yam, Buck Yam, Tannia, Hog Tannia, Eddoes, Sweet and Bitter Cassava being submitted.

Common Plantains were fairly good, the first prize particularly so.

Pumpkins were in fair quantity; only one fruit very large and this a particularly good one with very thick flesh. Most of the others were of the flattish form but regular in shape. As usual there was confusion as to forms, and this had to be rectified by the judges.

Tomatoes were very poor. The best in the Show were in the Model Gardens exhibits. Eschallots had but one exhibit of fairly good dry bulbs.

Ochroes, Peppers and Egg-plants (Boulangers) were fewer than usual but were good samples.

In the collections of Vegetables there was one very good exhibit. This included a good sample of Irish potatoes, but it is very doubtful indeed if they were grown in the colony.

Ground-nuts had but one exhibit. The fruits were large but old.

Green Vegetables and Salads were scarce and of rather poor quality. The best of these were exhibited in the Model Gardens section, where there were three splendid heads of fairly hard Cabbage.

ECONOMICS.

In the Economics, the exhibits of Coffee, both Creole and Liberian, were fair samples. The latter, however, was very fresh, and in both more careful picking and removal of broken and immature beans would have made them better samples.

The Cacao beans were fair exhibits, but they were all too fresh and not sufficiently cured. The Cacao Pods were not so good as formerly.

In the Rice there were two samples, marked "white" and "brown" respectively, but the white was browner than the brown, and the grains of both were very small.

In the Flours and Starches there were as usual splendid exhibits which Mr. Waby thinks could hardly have been beaten.

Cassava bread was also good and in quantity.

Dried Plantain samples were very fair, but the dried Bananas were very poor.

In Guinea Corn one sample of fair heads was shown, but these were only three instead of six.

The two samples of Tapioca were good.

The two samples of Tobacco were poor stuff and mouldy.

Ginger exhibited as dried was evidently just dug and washed. There was one fair sample: the other was small and irregular.

Cayenne Pepper and Curry Powder were good samples, the latter quite bright.

Of Cotton there were two samples said to be Sea Island—which they were not. These were under the required weight with seeds and lint together.

Copra was fairly good.

Turmeric—not on the list—had one fair sample.

In Jellies, Preserves, Pickles, Hot Sauces, etc., the samples were few and not above the ordinary grade.

Castor Oil and Coconut Oil were very bright and clear, and had been carefully prepared.

There were two bottles of Palm Oil, made from the pulp of the oil-palm fruit *Elais guineensis* which attracted the particular attention of His Excellency the Governor. He considered them fairly good samples but more liquid than he had seen elsewhere.

Prepared Chocolate was good and rather better than usual.

Of Butter the two samples were unsatisfactory.

In the Sugar Cane Section there were four particularly fine exhibits.

POULTRY.

There were nine exhibits of Fowls in which were some good birds. The arrangement of the cages was unfortunate so the judges took both pure-bred fowls and cross-bred as one section, the prize going to the pure-bred.

Fowls' eggs were all very small, as were those of the one exhibit of Turkeys' eggs.

Turkeys, two pairs of very fair birds, also one each of English and Muscovy Ducks. The prize Pigeons were good birds.

CATTLE.

Only one Milch Cow with Calf, and two Heifers ; clean, well-fed animals.

She-goats, 9 ; four with 2 kids, one with 3 and two with 1. All ordinary.

Ram Goats 4 ; one a big handsome white animal, and one just a kid.

Sheep, two small ordinary animals.

SCHOOL GARDENS.

The articles were very few and not up to the usual good standard.

The Model Gardens were better represented than the School Gardens and had some good exhibits. The Tomatoes. Cabbages, Lettuce, Radishes, Beet and Carrots were the best in the whole Show. Three boxes of Parsley were excellent.

FANCY ARTICLES.

A working Model of a Wind Riding Gallery, made by Mr. Alex. Hipplewith of the Kitty Village, was exhibited, with a few pieces of woodwork and a framed picture of Sunflowers in wool-work, the handiwork of Mr Hipplewith's sister.

FOREST PRODUCTS.

There was no competition in this class, but Mr. Hodgson of Pln. Noitgedacht had a splendid display on a separate table. There were two very fine spadices of fruit and a basket of loose fruits of the African Oil-palm. One spadix was fully ripe and the other not quite so. Of Para rubber there was a basket of seeds, branches, a small tank of freshly drawn latex, and two dozen large biscuits of rubber. The Silver Cup awarded to Mr. Hodgson in London last year for his rubber exhibit crowned the display. Besides these, there were 2 baskets of Coffee beans, 1 basket of three kinds of Castor Oil beans, 1 basket of French beans, and 1 basket of Cacao beans ; a good sample of Carrots, Beets, Corn, and 3 Cabbages,—two of the real pickling Cabbage and one green ; the red Cabbage being the first the reporter had seen grown in the colony—three bottles of Honey, 1 cake of Bees-wax, and a case of Honey in cells ; and 2 small bottles of Vanilla Essence. This table attracted considerable attention and was much admired by His Excellency the Governor.

BOARD OF AGRICULTURE STAND.

The Board of Agriculture had its usual pyramidal stand upon which fruits, economic plants, vegetables and products of general interest and utility were exhibited in Model style. As usual, the display attracted much attention and was greatly admired.

Reviews of Books Received.

"FORESTS OF BRITISH GUIANA."

BY

C. WILGRESS ANDERSON, I.S.O., F.G.S., F.R.G.S.

PROPOSALS for a systematic method of inspection and report on the Forests of British Guiana were sanctioned in 1908 by His Excellency Sir Frederic Hodgson, K.C.M.G., then Governor of the colony, and the work was entrusted to Mr. C. Wilgress Anderson, of the Department of Lands and Mines, who on the advice of the Director, Sir D. Prain, C.M.G., underwent a special course of training at the Royal Botanic Gardens, Kew, and was appointed Forestry Officer. The investigations were commenced on the 23rd June, 1908, and have since been carried on systematically within the easily accessible areas of the colony. A General Report has now been issued and a Detailed Report of the forests of the N. W. District of the county of Essequibo (Forest Districts 1–4).

It is obvious that in dealing with forests of so very mixed a character as those of British Guiana, descriptive reports, although interesting, would not be of sufficient practical value unless some definite method of estimating the different descriptions of forest trees was adopted, in order to obtain a clear idea of the many species growing in the "bush." The method pursued by Mr. Anderson is that of taking sectional surveys at places selected as being representative of the various classes of forests growing on different formations and in different situations. As the whole value from a practical point of view of these forest reports depends upon the results given by this method, it will be well to enter into some detail of it as set out by Mr. Anderson :—

"This method is based upon the established principle that 'given a certain combination of climatic and other ecological factors, soil, etc., a given area will be occupied by a definite association of certain plants, which will bear a fairly definite numerical relationship to one another. Some species will usually be very abundant or *dominant*, others will be *sub-dominant*, while others again will be comparatively rare, though usually occurring in similar proportions and in similar

areas. If the conditions of life change, as in passing from a level to a slope, from a slope to a rocky precipice, from well-drained to wet land, or from one soil to another, the grouping of the plants changes also, and the association is modified or passes over into another association more or less rapidly according to the rate of change of the conditions.' The results of the sectional surveys taken during my inspections have in every respect proved to be in conformity with the above rule.

"The procedure in making the surveys is a simple one, a representative place being chosen, squares of suitable dimensions for reckoning the trees included within them are marked out in the forests, and the different kinds of trees contained in each square counted and recorded. The results obtained from the combined areas of a certain number of such squares compose a sectional survey, and afford the means of estimating the number of trees of each species occurring per acre or in a square mile in the particular locality inspected.

"The number of squares necessary for obtaining reliable results by such a survey in anyone locality is essentially a matter of judgment. As a general rule the number required varies according to the uniformity or diversity of the species observed in the forest under consideration, more being required where the species are numerous and less where they are few.

"A further combination of the results of a number of sectional surveys taken in similar classes of forests within the same district is put forward in my estimates as constituting a forest type.

"Estimates of the kind indicated must of necessity be but approximate, yet the results so far obtained have been most consistent, particularly with regard to the prevailing kinds of forest trees, and they may therefore be considered as having proved to be sufficiently reliable for all practical purposes. They have been tabulated so as to clearly indicate the dominant, sub-dominant and other prevailing kinds of each type, while details as to the scarcer kinds are given in the appendix forms attached to each of the detailed forest reports.

"The calculation and tabulation work involved in their preparation is laborious and necessarily slow, but under the circumstances, from what has just been stated, the time expended on this work appears justifiable by the results obtained."

The girths of the trees it should be mentioned were taken breast high whenever it was found possible to do so. The minimum girth of the trees included in the estimates is eighteen inches.

For the purpose of inspection and report, the colony has been divided into twenty-five forests districts generally bounded by rivers and these are natural divisions with names that describe the particular portions of the colony which they contain. From a commercial point of view the forests are by local custom classified according to the predominance in them of trees yielding timber or produce of known commercial value: thus there are (1) Greenheart forests. (2) Wallaba forests, (3) Balata forests and (4) Other forests in which the above species are either absent or inconspicuous but in which scarcer species of known value occur.

As an example of Mr. Anderson's sectional method of analyzing forest growth the following table may be given. It relates to the forests bordering the rivers and covering the flat-lands slightly raised above the tidal level and more or less inundated during the rainy season.

FOREST TREES.	*Percentage of the trees.*	
Predominant Kinds—		
Mora	29·5	45·7
Trysil	9·9	
Kakaralli	6·8	
Other Prevailing Kinds—		
Crabwood		15·3
Wallaba (mixed varieties) ...		
Haiari-balli		
Corkwood		
Trees in Lesser Numbers.—		
Parakusan, Sarebebe, Kurakai, Wai-key, Dalli, Hatti, Maho, Ite-balli, Kauta, Aramatta, Bara-bara, Manni, Arisaura, Repe-repe-shi, Coffee Mortar, Kama-Danni		21·4
Scarcer Trees.—		
Of these seventy-eight different kinds were distinguished by native names, and in addition there were many undetermined ones ...		17·6
		100·0

It will be noticed that the Forestry Officer designates the trees by their vernacular names, and we understand that he has been at great pains to make sure that those names really apply to the trees in question. On page 20 of the Detailed Report is given a useful List of Woods in which, wherever possible, the botanical and vernacular names are given in parallel columns. Here again it is only where identification has been carried out fully that the scientific synonym has been ventured upon. A glance at this list shows what a great amount of work still remains to be done before the diagnosis of the trees of the colony can be considered complete.

It must be remembered that these reports represent the first attempt made by any country on the Continent of South America to investigate in a systematic way the possibilities of the forests; and Mr. Anderson must be warmly congratulated on the results of his painstaking, skilful, and often dangerous work. Much still remains to be done, but the beginning, as set out in these Reports, is full of promise.

—A. L.

The African Elephant as Farm Hand.

At last, after several years of failure, and probably for the first time since Hannibal used them in his campaigns in southern Europe some twenty-three centuries ago, the African Elephant has finally been put to work. At the new *Station de Domestication des Elephants* at Api in the Belgian Congo, there are some 35 or more fine young elephants, most of which are trained to the plow, the wagon, and the pack. However, these elephants are still young, probably from 6 to 12 years old, having been captured in the adjacent forest during the past two or three years. They promise to excel all other domestic animals for work on tropical estates.

—"Philippine Agricultural Review," March, 1912.

Answers to Correspondents.

A. L.—The larvae feeding on the lime trees were those of *Papilio anchisiades* and those on the Corn were *Laphygma frugiperda*, the Corn Ear-Worm.

C. D.—The larvae attacking the heart of your cabbages were those of the White Cabbage Butterfly *Pontia monuste*. The little green "flies" on the leaves of the Boulanger plants were Aphids. The leaves of the plants might be sprayed with tobacco water in which has been dissolved some soft soap. If the plants are too low to spray you should paint the solution on with a small brush.

A. L.—The larvae you sent in feeding on *Pentas rosae* are those of the Sphinx Moth *Xylophanes tersa* L. which has been previously recorded as feeding on Soursop (*Anona muricata*).

A. E. B. (Providence).—The grubs you forwarded attacking Sugar-cane are either those of *Ligyrus ebenus* our largest "hard-back" or of *Phileurus bajalus*. Hard-backs and other beetles can be caught by trap-lights. Pieces of sugar-cane put about the field would when they commence to ferment attract large numbers of beetles. It is probable that the insects can be caught under these pieces and they will also lay their eggs upon them. These trap-pieces should be collected regularly and destroyed.

S. P. & Co.—The scale insects attacking the Rubber trees were found to be *Saissetia nigrum*. The best method of control would be to spray them with Rosin Compound.

S. H. B.—The larvae sent in on diseased coconut palm pupated, but then died out.

L. P.—Unless you can make your store air-tight nothing can be done against the Flour Moth. You can try killing the adults by hand but you will probably find this rather slow and expensive. The 'parasite' method appears to offer the best prospects of effective control of the pest.

W. H. M., (Pomeroon).—The White scales you sent in on *Tephrosia purpurea* were the Orange Snow Scale, *Chionaspis citri.*

R.W.—The bark of the orange tree proved quite normal on investigation. The 'leprous' appearance was due to a small saprophyte of no consequence. The trouble the tree is suffering from is no doubt physiological and is probably, in this case, incurable.

C. Dowding.—The boulangers forwarded were attacked by a species of *Phytophthora,* most likely *omnivora.* This fungus is particularly deadly and is favoured by damp conditions. Cut out and *destroy at once* all infected fruit, and keep your cultivation *clean.* Try spraying the fruit, in its youngest stage, with Bordeaux mixture. Let us have further reports.

Ibid.—The cassava has been attacked apparently by a species of *Exoascus.* The mycelium seems to be confined to the young tissue of the growing point. Cut the plants back and spray.

P.K.—The rose bush is suffering from 'Rose Wilt' caused by *Sphaerotheca pannosa.* Better kill it out before the disease becomes established on the rosery. Spray with dilute sulphuric acid, 1 in 1,500.

A.A., (Issorora.)—The Hevea leaves you sent down were infected with an unnamed 'leaf disease' which occurs also in Surinam. It is, however, *not* caused by *Fusicladium macrosporum,* Kuijper. It does not seem to be of much importance, although it is wide-spread. It would be wiser, nevertheless, to recommend that all infected leaves be burned.

R.W.—The trouble on the rice-field is still under investigation. A fungus is certainly present but nothing definite concerning it is as yet ready for publication. Further notes on any recurrence of the trouble will be welcomed.

Hints, Scientific and Practical.

Pine-apples. GROWN on a soil adapted to its culture and receiving proper care, few plants are so exempt from insect pests and diseases as the pine-apple. Sifted down, the really serious troubles of the pine-apple are the mealy bug and wilt. The red spider sometimes appears in sufficiently large numbers to be regarded as a pest .

The mealy bug is the only insect pest of importance ; it attacks the leaves at their base and is usually distributed by ants. At the Porto Rico Experiment Station, a kerosene and crude carbolic acid emulsion was found to be an effective remedy for this insect, prepared according to the following formula :

Kerosene	liters*	15.0
Crude Carbolic Acid	do.	.9
Soap	kilograms†	.5
Water	liters	7.5

Dissolve the soap in boiling water, together with the carbolic acid, and while still hot add the kerosene. Churn the liquid steadily for fifteen or twenty minutes by the use of a force pump, the liquid being pumped back into the vessel until it is emulsified. For spraying, dilute each liter of the emulsion with 18 liters of water.

In spraying for mealy bugs, it should be remembered that the force of the spray should be sufficient to penetrate the mealy covering of the insect and saturate its skin in order to be effective. It is, therefore, necessary to direct the spray into the heart and between the leaves of the plant. The ants should also be eradicated by spraying into their nests. In order to reach all it is usually necessary to spray the nest two successive days.

If the plants are suffering from a very serious attack and the affected area is not large, perhaps the best remedy is to take out the plants and burn them, insects and all.

Red spiders sometimes cause injury during prolonged dry weather, but they are readily exterminated by the use of

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* 1 liter = 1·75 pints.
† 1 kilogram = 1,000 grams = 2·21 lbs.

tobacco dust, which is scattered over the plants. Like the mealy bug, the red spider attacks the plant at the base of the leaf.

The pine-apple scale has never been known to occur in sufficient numbers to cause serious trouble.

The wilt is due to a fungus (*Fusarium* sp.). This disease is characterised by the loss of color in the leaves, which change from green to a sickly red and yellow, at the same time shrivelling and wilting.

The organism that causes the wilt inhabits the soil and the disease cannot therefore be treated like ordinary fungus parasites.

All diseased plants should be pulled out and burned, and the land affected covered with quicklime and left to lie fallow. The soil should in the meantime be stirred from time to time. After two months the land may again be reset with healthy plants. Under no circumstances should plants suspected of having the wilt be set out in a new field.

—P. J. Wester, (Horticulturist; Bureau of Agriculture) in "The Philippine Agricultural Review," October, 1912.

The Profitable Culture of Orchids.

THE epiphytic orchids seem to flourish in their native habitats without any visible sustenance. However, they receive more or less from the vegetable matter that collects in the crevices of the bark of the trees where they support themselves and in some cases they send out a stiff "brush" of roots at the approach of the rainy season, pointed upwards and outwards to catch falling leaves. etc., and thus they supply themselves with the best conceivable plant food, and are really far more terrestrial in their habit than a superficial study of them would indicate. In this lies a hint for the would-be orchid grower that few appreciate. As is well-known the tropical rains carry a considerable amount of nitrogen which also benefits the plants.

While our orchids delight in a drenching tropical shower, perfect drainage is none the less essential, both during the rainy and growing season, as well as during the dry and flowering season, and whatever receptacle is used in which to

suspend the plant, it should be constructed so that no water collects and sours the medium in which the plant is to grow. Coconut husks held together by galvanized or copper wire make unique and attractive receptacles for orchids, or baskets may be made of hard slow-decaying wood. To be attractive and to serve its purpose well, an orchid basket should be just large enough to hold the plant without crowding it; if a large specimen is desired, several plants may be put in one basket. About half or more of the basket should be filled with broken pots and charcoal and the plant then "basketed"—that is, planted in the basket. In doing this, place the plant in position in the basket and work in among the roots equal parts of leaf mold and decaying leaves, and bits of charcoal and broken potsherds. Do not set the plant so deep that the buds from which the new growth, or 'pseudobulb' as it is called technically, springs are under, but rather just about even with the soil surface. In order to hold the plant until it has taken root, wind wire over and around the basket. This work should be done a little before the advent of the rainy season just as the plants are starting into growth, and the plants should be watered sparingly until they come into active growth. If they are not exposed to the summer rains they should be watered regularly and never allowed to become so dry that the growth is arrested. It is also beneficial to feed the plant by watering it with or dipping the basket in cow manure water of about the color of weak coffee every two or three weeks. Lacking manure water, a chemical fertilizer answers very well. The writer has found that the following formula produces excellent results applied at intervals as stated above:

Nitrate of soda	grams	27
Sulphate of potash 49%	do.	12
Acid phosphate 16%	do.	30
Water	liters	10

The fertilizer should be well dissolved, and the solution stirred from time to time in order to prevent the acid phosphate from settling to the bottom. It is probable that low-grade sulphate of potash or muriate of potash can be used in lieu of the high-grade. Twenty-five grams of either of these fertilizers should then be dissolved in 10 liters of water. If superphosphate is used instead of acid phosphate about 10 grams will suffice.

By this artificial forcing the writer has obtained in one season two growths instead of one, and has doubled the amount of bloom produced.

Any man who is at all interested in his plants will notice when the pseudobulb has attained its full growth. It then swells out and 'fattens up,' to use the term of the professional grower. The leaves also begin to lose their freshness. If this is well towards the dry season, water should be gradually withheld until the plant is left almost dust dry. The leaves of the deciduous species, such as the *Dendrobium superbum*, so frequently seen in Manilla, now fall and later the flower buds appear. Then and during this period of ripening of the pseudobulbs and the season of flowering, supply water sparingly, or barely enough to prevent the pseudobulbs from shrivelling too much and the flowers from wilting and the reward will be fine sprays of bloom lasting in some species several weeks before they fade, after which the cycle in the life of the plant is past. If it can be avoided the pseudostems of a plant, as long as they are in good health, should never be removed for this is a drain upon the vitality of the plant.

Many orchids like the *Cattleya* and *Laelia* and *Oncidium* are not deciduous. However, their treatment is essentially the same as described above: with some of these species it is necessary to withhold water until the entire plant is quite shrivelled up before it yields flowers. Likewise certain species of *Dendrobium* may produce fine pseudostems for year after year but fail to bloom until they are properly dried up. On the other hand, certain orchids devoid of pseudobulbs or stems, such as the genera *Phalaenopsis* and *Cymbidium* should receive a moderate amount of water throughout the year.

With reference to light it may be stated that the more light and sunshine the plant receives without excessive exposure to the sun, the more flowers will it produce; particularly is this true during the dry season, and during the resting season of the plants before they come into bloom. In this, as in other respects, the orchid grower cannot do better than to study the individual species in their native habitat and environment.

—P. J. Webster: in "The Philippine Agricultural Review," September, 1912.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods, setting out the number of pupils who attended the Model Gardens of the colony from April 1, 1907. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to March 31; April 1 to June 30; July 1 to September 30; and October 1 to December 31. The totals only during 1907 and 1908 are given; the records since then are in detail.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1907.										
2nd to 4th	1,261	928	994	835	556	...	...	...	...	4,574
1908.										
1st to 4th	5,447	3,386	1,477	887	1,053	160	...	...	...	12,410
1909.										
First	1,638	710	338	463	370	302	...	...	...	3,821
Second	1,707	677	329	142	288	446	...	...	...	3,589
Third	¶1,252	742	433	436	172	378	223‖	...	...	4,636
Fourth	1,876	536	438	236	362	771	439	...	...	4,858
1910.										
First	1,282	769	287	370	259	489	465	..	...	3,921
Second	1,311	558	787	894	303	455	519	403§	...	5,240
Third	¶1,234	526	910	748	294	510	498	537	...	5,257
Fourth	1,209	444	1,285	336	295	493	502	592	...	5,156
1911.										
First	1,086	360	1,042	838	312	514	414	572	577	5,695
Second	1,263	326	713	816	286	292	536	591	688	5,511
Third	¶1,093	385	910	627	361	297	543	441	639	5,296
Fourth	1,687	448	935	588	447	406	737	957	540	6,745
1912.										
First	1,127	379	1,374	1,034	425	207	573	359	423	5,901
Second	1,385	359	1,096	900	484	553	730	461	413	6,381
Third	1,416	400	763	889	412	572	621	616	443	6,132
Fourth	1,586	254	1,162	479	459	768	620	720	439	6,487

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

¶ Schools in vacation during August.

‖ Instruction commenced in July.
§ Instruction commenced in April.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported during 1912. The corresponding figures for the three previous years are added for convenience of comparison :—

Product.	1909	1910	1911	1912.
Sugar, tons ...	115,633	106,439	9,8459	77,788
Rum, gallons ...	2,154,317	2,005,873	2,595,293	2,382,937
Molasses, casks ...	2.539	2,084	1,106	1,760
Cattle-food, tons ...	9,504	9.379	5,556	5,116
Cacao, cwts. ...	574	472	798	102
Citrate of Lime, cwts.	54	87	56	½
Coconuts, thousands	636	994	1,038	1,042
Copra, cwts ...	467	306	1,415	1,149
Coffee, cwts ...	1,122	1,049	927	1,293
Cotton, lbs. ...	...	...	...	..
Fruit, brls. and crates	1	...	...	...
Ground Provisions, value	$225 32	$546 12	..	...
Kola-nuts, cwts. ...	38	9	4	...
Rice, tons ...	4,729	4,927	2,538	2,721
Rice-meal, tons ...	1,911	1,620	1,364	2,005
Starch, cwts. ...	..	4	...	...
Cattle, head ...	992	1,210	953	497
Hides, No. ...	3,490	5,569	4,617	4,230
Pigs, No. ...	872	1,090	1,148	1,159
Poultry, value... ...	$ 224 25	$ 72 36	...	..
Sheep, head ...	74	123	40	71
Balata, cwts. ...	9,231	11,302	10,289	6,296
Charcoal, bags ..	78,410	76,681	72,937	67,573
Firewood, Wallaba, etc., tons ...	8,499	10,192	9,866	8,759
Gums, lbs. ...	6,916	2,529	4,652	4,958
Lumber, feet ...	210,137	277,313	327,328	223,571
Railway Sleepers, No.	3,350	9,950	5,432	5,280
Rubber, cwts. ...	57	14	32	2
Shingles, thousands	2,122	2,463	2,599	2,562
Timber, cubic feet	219,516	278,382	234,003	284,530

Selected Contents of Periodicals.

Plant Pest Remedies.
Yams.
Roselle (Sorrel), Its Cultivation and Uses.
Rats.
Anonaceous Fruits and their Propagation.
The World's Widest-known Fruit (The Banana).
The Mango.
The Coconut Number.

—The Philippine Agricultural Review, 1912.

Chicken Rearing on an Intensive System.
Parasitic Mange in Horses, Asses and Mules.

—Journal of the Board of Agriculture (England), Dec., 1912.

Hevea Seed.
Production of Sulphate of Ammonia.
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JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL VI. APRIL, 1913. No. 4.

The Prevention of Malaria.

NOTHING could have been more striking than the figures adduced by the Surgeon General when on Friday, April 18th, at a meeting of primary school managers and teachers he introduced His Excellency's scheme of distributing quinine free to school children as a prophylatic measure against malaria. Quoting a report of the Inspector General of Prisons in the Punjab, Dr. Godfrey showed that in that district of India, while 90% of the free population suflered from malaria, only 10 per cent. of the inmates of the jail were affected; for the simple reason that every prisoner had to take 15 grains of quinine per week. In Mianwala 33 per cent. of the population applied for relief at the Local Hospital while in the jail only 1 per cent. went down with malaria: in the schools of Luadiana from 85 to 88 per cent. of the scholars absented themselves owing to malaria, in the jail only 3.84 per cent. suffered at all. Dr. Godfrey proceeded to show that similar methods in British Guiana had given similar results. Some years ago he instructed the jail surgeons to see that all prisoners were treated with quinine. The consequence was that there had been a great reduction of malarial fever among the prisoners in the gaol. Other ailments had also disappeared, the prisoners being better able to resist disease through being free from malarial parasites. He went on to detail what had been done on the sugar estates of the colony, quinine being distributed freely among the immigrants. The Government at about the same time resolved to allow quinine to be sold at the Post Offices all over the colony at 15 grains for one cent. This had been much appreciated and the sales of quinine at the Post Office had risen

considerably since the starting of the practice in December 1906. Free quinine had also been given to warders and their families and to inmates of the Orphan Asylum, the Almshouse, and to policemen and their wives in those cases where they lived within the compound. The next step was to establish a free distribution of quinine at Queen's College. And now the scheme has been extended, and the children attending the primary schools in Georgetown and in New Amsterdam are to benefit by the free distribution of the prophylactic.

We must enter into some detail regarding the returns from the sugar estates; they are so convincing that we should like to see copies of the original charts made—there is nothing like the graphic method to bring home statistical statements—and placarded in public places for the inspection of all and sundry. Quinine distribution on the plantations was commenced in 1906, when 33,748 cases of malarial fever were returned as having been treated in the estates' hospitals. The distribution did not become general and systematic until 1910 when, in spite of the year being a wet one, the number of cases fell to 21,063. For the financial year 1912-13 the number of cases will be, when the returns are complete, about 7,000. A striking demonstration, surely.

Taking individual estates the results are equally gratifying. Plantation Rose Hall, (Berbice) which in 1907 returned 1,924 cases of malaria, in 1912 recorded 768 only. The figures for 1912-13 will be somewhere about 500. Plantation Marionville with 1,186 cases in 1906 reduced its figures to 307 in 1912, and during November, December, January and February of the last financial year had only 5 cases in hospital in the four months. Plantation De Kinderen, which in August 1906 had 184 cases in hospital, in 1912-13 went for ten months with less than ten patients during each month and will return a total of cases for the whole year of about sixty. Plantation Providence (Demerara) which in 1907 recorded over 100 patients in January now counts its cripples from fever by ones and twos and sends in a total of 29 for eleven months of the last financial year as compared with 260 for the same period of the previous year. But the most remarkable instance is that of Plantation Cove and John. For seven consecutive months—June to December 1912—the estate's hospital had not a single case of malaria to treat, and for eleven months of the year the total number of cases was only seven. This astonishing result can be understood when we

read in the report of the Surgeon-General that the children on this particular estate are so fond of the sugar in which the drug is administered that the chief difficulty of the estate's authorities is to prevent the youngsters from getting two or three doses of quinine a day!

Such results deserve the widest publicity and should go far to remove the last traces of that prejudice against quinine which still prevails among the people of British Guiana. How wide spread and fixed this prejudice was can only be realized by those whose duty took them among the people. Deafness "nerves," "bad feelings," a dozen different complaints, were predicted as *sequelæ* of the administration of quinine and (what is more) firmly believed in, while it was almost impossible to convince the ordinary person that infantile convulsions—so important a factor in the death-rate of the children—disappears practically where quinization is properly established. It is here that the work of the Department of Science and Agriculture in connection with the campaign against malaria may perhaps be judged of value. For eight years past that Department, by means of organised lectures which have been attended now by nearly all the school teachers of the colony, has hammered away at the wall of prejudice and ignorance which has stopped progress, and now that the Medical Department has taken steps to put the administration of quinine on a practical basis the way should be clear for the success of the scheme. At least a well-sustained appeal has been made to the most intelligent section of the populace, and through that section the notion of quinine as a prophylactic of unique value has been spread. To the obvious surprise of the Surgeon General, one head teacher* at the meeting announced that he had already instituted the administration of quinine at his school and was able to justify this course by results. On the whole, then, progress can be reported and practical results should now be possible. But the steady spade-work which will have rendered those results possible must not be forgotten.

* The name of this headmaster deserves to be recorded: Mr. S. A. Robertson, of Agricola Wesleyan School.

Entomological Notes.

Froghoppers.

THERE is a species of froghopper which is occasionally found attacking rice and grasses in this colony. Specimens have been forwarded to Mr. F. W. Urich, Entomologist to the Board of Agriculture, Trinidad, who pronounces them to be a new species. Determination with description he hopes to publish later.

An Internal Parasite of Coccinellids.

THERE are several species of local Coccinellids which prey on the Sugar-cane Mealy Bug (*Pseudococcus calceolariæ*) in British Guiana. A number of these in the larval and pupal form were recently collected at Pln. Lusignan and brought to the laboratory for observation purposes. After some days a number of Hymenopterous parasites were observed in the tube and on inspection the emergence holes of parasites were seen in several Coccinellid pupæ. These parasites will shortly be sent away for determination by a specialist.

Food Plants of *Sibine.*

THE larvæ of the Limacodid, *Sibine trimacula,* would appear to be practically omnivorous. The following records of its foodplants have been recently received :—Coconut Palm, Rose leaves, Soursop, Avocado, Breadfruit tree, Castor Oil as well as many ornamental garden plants.

The so-called Demerara Silkworm, *Rothschildia erycina* (*Attacus hesperus*) normally has a somewhat lengthy pupal period. Two larvæ of this insect pupated on 22nd January, 1912, and some seven months later, as no sign of the emergence of the adult moth were perceived, the cocoons were cut open and the contained pupæ were found to be still living. These two pupæ are still alive (May 6th, 1913) which gives a pupal period of 15 months—apparently a most remarkable record.

Insect Pests in Uganda.

WE have recently received from Mr. C. C. Gowdey, B.Sc., F.E.S., F.Z.S., Government Entomologist of the Uganda Protectorate, a Bulletin entitled "An Account of Insects Injurious to Economic Products, and their Control." Short notes are given at the commencement on the classification of

insects which are written in a popular style and should consequently be easily understood by untrained people. The injurious insects are treated under the crops to which they are injurious. We notice that the insects recorded as attacking rubber plants, apparently Castilloa, include a wood-boring beetle and Termites, neither of which seem to be seriously harmful. Citrus pests include a species of *Papilio* and the well known Coccid, *Mitilaspis citricola*, Pack. *Calandra oryzæ*, the Rice Weevil, is also present, as well as the Sweet Potato Weevil, *Cylas formicarius*, F. A Palm Weevil, *Rhyncophorus phœnicis*, F., is noted as being destructive to practically all the species of palms occuring in Uganda. The Bulletin concludes with an account of the histories and preparation of a large number of insecticides and fumigants.

A Parasite of Laphygma frugiperda.

ISSUE No. 6 of Vol. 5 of "The Journal of Economic Entomology" contains an exceedingly interesting account or the parasitism of The *Laphygma frugiperda*, by *Chelonus texanus*, Cress. Apparently this insect has the peculiar habit of ovipositing in the eggs of *Laphygma*, while the adult parasite emerges from the larva. The adult parasite is approximately half as large as an ordinary house fly and about as large as an egg mass of 60 *Laphygma* eggs. Eggs of *Laphygma* thus parasitized hatch in a normal manner but the larva when about half-grown prepares a pupal cell supported by a fine-meshed silken cocoon. Two days after the completion of this cell the larva dies and on the following day the larva of the parasite emerges from a hole in the centre of the body of the caterpillar. The larva of the parasite then commences to spin its cocoon of white silk within the yellow cocoon of its host taking several days for the process. A parallel case was observed by the writer in the cane fields of Porto Rico early in January of this year. As *Laphygma frugiperda* commonly occurs in British Guiana it is quite possible that this curious parasite is also present.

Notes on Diatræa.

Number of eggs contained by Diatræa. With a view to obtaining information on this point a number of Diatræa pupæ were collected and on the emergence of the female moths they were dissected and the number of eggs in the eight egg tubes counted. In three females the number of eggs contained,

including those in a very early stage of development towards the end of the tubes, were respectively 716, 742, 731.

Proportion of males to females in Diatræa spp. From 107 pupæ collected at Pln. Anna Regina and hatched in this laboratory, examination showed 51 to be males and 56 females.

A new predaceous enemy of Diatræa. On several estates recently there has been observed amongst the *Diatræa* larvæ cut out of the canes by the gangs employed for the purpose the larvæ of an Elaterid beetle. Enquiries elicited the information that these were invariably discovered in the tunnels of *Diatræa*. To test whether these larvæ were actually predaceous on *Diatræa* a number of cane shoots containing these Elaterid larvae were obtained from Pln. Anna Regina through Mr. J. Dodds. These were placed in a breeding jar in the bottom of which were placed several layers of moistened blotting paper. The following morning the pupae had been entirely hollowed out and the larvae were still feeding on the remains. Under natural conditions it is probable that they are not entirely carnivorous but their continued presence in the borings of *Diatræa* indicates that whenever opportunity occurs they will destroy Diatræa either in the larval or pupal stages. The matter is receiving a close investigation.

The Parasite Question.

MANY attempts have been made during recent years in all parts of the civilised world to control injurious insect pests by means of other insects which are either parasitic or predaceous on those pests. It may almost be said that it has become fashionable at the present time among economic entomologists when dealing with insect pests to pay considerable attention to the possibilities of parasite control. Theoretically, the matter presents great possibilities, practically it is often disappointing. But few recognised cases exist where pests have been controlled by these means, and these have been under particularly favourable circumstances.

To the lay mind the scheme is of course an exceedingly attractive one, the argument being that if parasites can be made to do the work there is no necessity for tedious and expensive artificial control measures.

When the not unusual conditions of tropical agriculture are taken into consideration—the huge areas under cultivation, the lack of skilled labour and intelligent supervision, and the

many complex problems intimately connected with climate and insect life itself—the possibilities of such control measures become remote.

The solution of insect control problems invariably lies in the simplest and most direct methods. Sound cultivation, a conscientious execution of well-proven means of control, and above all an intelligent comprehension of the matter in hand may be termed essentials. It is the absence of such that not infrequently compels the economic entomologist to a consideration of the possibilities of much less reliable parasite control methods.

The Late Miss Ormerod and Insect Pests in British Guiana.

THE following notes are extracted from the Proceedings of the Entomological Society of London for the year 1879 and are of particular interest in connexion with modern theories as to the control of sugar cane insects in British Guiana.

Miss E. A. Ormerod, the well-known English Economic Entomologist, read a paper at a meeting of the Society entitled 'Sugar Cane Borers in British Guiana' specimens of three classes of borers including the Moth Borer (probably *Diatraea saccharalis*), the small Weevil Borer (probably *Metamasius hemipterus*) and the large Weevil Borer (probably *Rhyncophorus palmarum* or a closely allied species) were exhibited. She quoted the following observations on the life history of the moth borer which had been made by several individuals in this colony. 'The moth lays its eggs on the tender inner leaf of the cane and the grub when hatched lives first of all on the tissues of the leaf till its mandibles become sufficiently hardened to attack the cane itself. In the cane it drives galleries 15 to 18 inches in length principally in an upward direction. The entrance hole to the tunnel is closed by debris serving as a protection against ants. The prevalence of the borers was ascribed to (1) the use of strong chemical manures, (2) long droughts and hot weather. The combination of these serve to drive away from the fields the enormous multitude of ants which in ordinary seasons, attracted by the dew in the hollow between the caneleaf and its stem, carry off also the eggs and young larvae of the borers.'

At another meeting of this Society Miss Ormerod read some further notes on the presence of the moth borer in the cane fields. The practice of burning the canes had been observed to

result in an increase of these pests due to the destruction of the ants which have been repeatedly observed to perform valuable work in the destruction of this pest.

Froghopper Control.

We have just received from the Board of Agriculture of Trinidad and Tobago, Circular No. 7 entitled "Rearing of the Vermillion Froghopper egg parasite" by F. W. Urich, entomologist. It consists of some exceedingly original and interesting information with regard to the following points:—Collection of material from which parasites issue, types of special breeding cages, method of breeding, liberation of the parasites, and some biological notes on the parasites.

The parasite itself belongs to the *Mymaridæ*, and judging from specimens kindly forwarded to this office for examination by Mr. Urich, is a bright vermillion in colour and less than one millimetre in length.

Grass, where either the characteristic spittle of the larval froghopper or the adults themselves are seen in considerable numbers, is best for obtaining the parasites, as it is safe to assume that when these stages are plentiful the eggs will also occur. The eggs (it should be noted) are hard to find as they are deposited in the old withered parts of the grass about the roots.

This grass is placed in large light-tight wooden boxes furnished with glass tubes which are let into the sides; the principle being that the parasites on emergence at once go to the light and consequently enter the tubes. When the parasites appear they are fed with small drops of diluted molasses and also supplied with the eggs of the froghopper (previously deposited by adult froghoppers in confinement) in which to oviposit. Large numbers of the parasites may then be reared and distributed in localities where they do not exist or are small in numbers.

Great credit is due to Mr. Urich for the methods which he has devised. As one of the several methods of controlling this pest, they should prove exceedingly helpful.

Circular No. 8 of the Board of Agriculture, Trinidad and Tobago by Mr. J. B. Rorer, the Mycologist, deals with another method of controlling the froghopper. The Green Muscardine fungus (*Metarrhizium anisopliae*) was known to attack the froghopper in Trinidad as far back as 1890 and the aim of this circular is to show that it may be utilised on a large scale under field conditions as a control method.

The use of large cabinets some 6 feet high and 3 feet square is recommended by Mr. Rorer for production of large quantities of fungus. Sterilized rice is best for this purpose. Several methods of applying the fungus in the field have been tried with success. The fungus spores are distributed over infected areas by means of hand dusting machines, or a number of boys are sent through the cane field catching adult froghoppers allowing them to jump iuto glass tubes infected with the spores, and then to escape—thus spreading the infection naturally.

G. E. B.

The Monetary Value of Preventive Measures.

This bulletin has been prepared to place before the peach growers of the United States the results of experiments conducted during several years past for the prevention of peach leaf curl. The losses arising from this disease frequently amount to several millions of dollars annually, and it is believed that a wide dissemination of the results obtained by the experiments here outlined will lead to a large saving to the peach industry. During the process of the Department's work over one thousand six hundred peach growers in all peach-growing States have been requested to test the preventive measures here recommended. A large number have done so, and some of the more important results of their work are also given. From conservative data it has been estimated that the experimental work thus widely set on foot by the Department has saved to the country in a single year the sum of three-fourths of a million dollars. This is but a fraction, however, of what may easily be saved in the future, when all growers have obtained a more thorough understanding of the disease and its preventtion.

Peach Leaf Curl: Its Nature and Treatment."

The Rice Caterpillar.

Laphygma frugiperda, S. and A.

A RICE PEST IN BRITISH GUIANA.

By G. E. Bodkin, B.A., Dip. Agric. (Cantab.), F.E.S., F.Z.S., Government Economic Biologist.

CLASSIFICATION AND HISTORY.

THIS somewhat inconspicuous insect belongs to the Lepidoptera, family *Noctuidae*, genus *Laphygma*. It is well known both in North and South America and the West Indies, having received considerable attention from time to time. It was first noted by Smith and Abbott* in 1797 who termed it *Phalaena frugiperda*. It has recently been described by Sir G. F. Hampson in his Catalogue of the *Lepidoptera Phalaenae* in the British Museum, 1909.

Its synonomy is as follows :—

Laphygma macra Guenée
Laphygma signifera Walker
L. plagiata Walker
L. autumnalis Riley
Phalaena frugiperda. Smith and Abbott
Trigonophora frugiperda Geyer
Prodenia autumnalis Riley

In the United States it has received at different times a large number of popular names but the one now in general use is 'The Fall Army Worm.' As this is hardly applicable to the insect in a continuous tropical climate like that of British Guiana, it has been decided to call it the "Rice Caterpillar," especially as its attentions in these parts are confined to rice or grasses.

DISTRIBUTION.

In North America it is met with throughout the Atlantic States and the Mississippi Valley and from thence it is distributed southward through Central and South America. Sir G. F. Hampson notes the following places where the moth has

*Smith and Abbott. Natural history of the Lepidopterous insects of Georgia. Vol. 2, p. 191, Plate 96.

been taken :—Canada, New York, Pennsylvania,, Florida, Texas, Mexico, Guatemala, Honduras, Costa Rica, Panama, Jamaica, Cuba* ; Haiti, St. Lucia, Grenada, Barbados, British Guiana, Brazil, Uruguay, and the Argentine. As far as can be determined this insect has never previously been reported as being of actual economic importance in the West Indies.† In this colony the larvæ have been observed feeding on young rice in practically all the rice-growing districts, and the insect undoubtedly occurs throughout. The moth has also been observed in large numbers on grasses about the uncultivated lands.

ECONOMIC IMPORTANCE AND METHOD OF ATTACKS.

In certain parts of the United States, chiefly the Southern portion it is of great economic importance. Bulletin No. 29 of the Bureau of Entomology, United States Department of Agriculture, deals with this pest and gives a number of instances of damage done by it at different periods from the year 1797. This year (1912) *Laphygma* has again broken out in the United States, damaging largely Indian corn or maize, great quantities of which are grown.

In British Guiana it has shown itself to be an extraordinarily destructive pest, occurring as it does in countless numbers in the young rice nurseries when the plant is at the most critical stage of its growth. In a short time, if control measures are not immediately taken, it will destroy the entire nursery.

A number of cases have been met with where the larvæ have been allowed to have their own way with the result that the crop has had to be re-sown. In the younger stages the larvæ feed on the epidermal tissues of the leaves, producing yellow patches which eventually turn grey and wither. Later they consume the whole leaf, or else they bite through the leaf at its base causing it to fall off. Movement from one plant to another is easily accomplished owing to the proximity of the plants themselves.

On sugar-cane, which they have occasionally attacked, they devour the younger and more succulent blades often leaving

*An account of the economic importance of L. frugiperda in Cuba appeared in Bull 7, 1907 of the Estacion Central Agronomica de Cuba. 'Insects and diseases of Corn, Sugar Cane and related plants.

† Since this article was written *L. frugiperda* has been mentioned by Ballou in "Insect Pests of the Lesser Antilles," where he calls it the "Corn Ear Worm" and also states that it is a cotton pest.

only the midrib. They attack grasses much in the same manner as they attack rice.

FOOD PLANTS.

These include a large number of commonly occurring grasses besides rice and sugar cane. The egg masses may also be observed on these plants. Young rice seems to be a particularly favourite food-plant judging by the numbers of the larvæ and the frequency of the attacks. In the laboratory they have been successfully fed on different kinds of grasses, but in the earlier stages they thrive best on young rice shoots. In British Guiana they have never been seen to feed on cotton. In the United States they attack cereal crops such as maize; they have also damaged clover and different varieties of peas.

LIFE HISTORY.

Popular descriptions will be given here of the different stages, with observations of interests, and from these it should be possible to recognise the pest in the various stages of its existence.

THE EGGS.

These are invariably deposited in somewhat irregular masses, the numbers in each mass varying from 30 to as many as 200. In some cases the eggs are laid in a double layer. They are deposited on either the upper or lower surface of the leaves, usually towards the midrib. The female moths seem to be somewhat erratic as regards the plants selected for oviposition, for egg masses have been observed on the leaves of the rubber plant (*Hevea brasiliensis*) and several other plants differing widely from the usual food.

When deposited they are a very light grey colour and slightly opalescent. As development proceeds they appear darker in colour. The whole mass is completely covered by the female moth in the act of oviposition with very fine short transparent hairs of a greyish colour which are 'felted' together and give the mass a quite characteristic appearance. The hairs on some egg masses are thicker than on others. If a separate egg is taken and slightly magnified it will be seen to be covered by a number of very fine curling hairs which are transparent and shining. The appearance of these hairs cannot be better described than as closely resembling the 'hyphae' or branching threads of a fungus growing out from the egg itself.

The average measurements are as follows :—

Diameter	.42 m.m.
Height	.27 m.m.

In shape the egg is spherical, being slightly flattened at the base.

On magnification the surface of the egg as viewed from above will be seen to be marked with faint lines or ridges radiating from the centre. Seen by transmitted light the eggs are yellowish white with a distinct pearl-like lustre. Just before the larvæ emerge they turn a dark grey colour. The number of eggs deposited by each female has not been determined, but it must be several hundreds. Two and a half to three days elapse between the deposition of the eggs and the first appearance of the larvæ.

THE LARVAL STAGE.

This occupies, when attacking rice, about 16 days though some slight variations occur. During this period the larvæ undergo a series of moults and change their colours very considerably. Larvæ about a week old are of a distinct green colour, but when fully grown they are quite black on the dorsal surface. They are at all times very active and move from plant to plant with the greatest ease, despite the often meagre foothold to be obtained. If they chance to fall into the water at the foot of the plants they quickly regain their position by a series of wrigglings movements which propels them over the surface of the water. They are kept afloat by the surface tension acting on the many short hairs with which their bodies are covered.

A curious fact was observed in this connection. If a large nearly full-grown caterpillar fell from the top of the plant into the water, its weight combined with the length of the drop was sufficient to destroy this surface tension, and it sank never to re-appear. Young larvæ, however, under the same circumstances always kept afloat owing to their lighter weight.

When irritated the larvæ quickly exude from their mouth parts a quantity of green fluid which must protect them to a certain extent from their enemies.

Their cannabalistic tendencies are truly remarkable. Indeed from observations it would appear that they prefer this diet

to a vegetable one were it always obtainable. The larger larvæ invariably kill and devour the smaller ones whenever met with. As an example of this may be given an actual instance which occurred in the laboratory.

Some 15 larvæ composed of five nearly full grown caterpillars and the rest either only half-grown or in the earliest stages of development, were placed in a breeding jar, and provided with grass on which to feed. Next morning only the five largest and one of the smallest were found in the jar, the others having been destroyed by those five remaining large ones. During the day the one remaining small one disappeared.

This habit (not unusual among the *Noctuidae*) must in some degree reduce their numbers, but it must be borne in mind that under natural conditions,—in a plot of young rice for instance—unless occurring in very large numbers they are too widely scattered to allow of much cannibalism.

EMERGENCE OF LARVAE FROM THE EGG.

The young larva bites a hole in the side of the egg shell, through which it emerges. In some cases the larvæ partly devour the empty shell but usually they are left intact, and appear as transparent shining objects on the leaf blade. In the space of a couple of hours all the eggs in the mass are emptied and the larvæ may be seen collected together in a greyish mass on the eggs. They soon disperse in search of food.

In this stage they have the power of letting themselves down from the leaf by a fine silken thread. This greatly facilitates their search for food, and by its means they cover considerable distances.

FIRST INSTAR.

On emergence from the egg the colour of the young larvae is a very dark brown. The whole body is slightly covered with a number of dark tubercles each bearing a short bristle-like black hair. These tubercles are arranged in roughly transverse bands on each segment. The head is large in proportion to the rest of the body, black and shining.

The average measurements on emergence from the egg are :—

Length 2.3 m.m.
Breadth 1.9 m.m

DESCRIPTION OF LARVAE ABOUT 7 DAYS OLD.

The colour of the upper portion of the body is dark green with the head dark brown. The whole of the upper surface of the body is sparsely covered with short black bristly hairs each arising from a well defined black tubercle. There is a thin, central dorsal, longitudinal light coloured stripe commencing just behind the head and extending to the anal extremity, and two other similar dorsal stripes equidistant from the central one, are to be observed. The dark green colour of the upper part of the body terminates just beneath the stigmatal line and at its termination there is a somewhat indistinct longitudinal reddish stripe. The under surface of the body is a light yellow green.

The average normal measurements at this stage are as follows :—

Length 15.0 m.m.
Breadth 2.2. m.m.

DESCRIPTION OF FULLY GROWN LARVAE.

The upper surface of the body is now black in colour with the same arrangement of tubercles and hairs as in the previously described stage. A very faint, interrupted, longitudinal dorsal central stripe of pale sulphur yellow is visible, more distinct on the thoracic and anal segments. Equidistant on either side of this stripe, dorsal in position there are two other pale sulphur yellow stripes, more distinct than the central stripe. The black colouration of the upper surface of the body terminates at the spiracles on either side, and at this termination there is a comparatively broad sulphur yellow stripe. The under surface of the body is yellowish green. The thoracic and abdominal feet are greenish. The head is black and covered with a few fine hairs.

The average normal measurements are as follows :—

Length 30.5 m.m.
Breadth 3.9 m.m.

A technical description of the various larval stages of this insect has been given by Harrison G. Dyar in the previously mentioned Bulletin of the United States Department of Agriculture. The colours described however vary somewhat from those given above, which are probably due to the character of the food plant.

PUPATION.

When fully fed the larva leaves its food plant (in this case young rice) and makes its way to the nearest dam of mud or earth; when this is reached it crawls into a crack or other opening in the soil and there forms a roughly circular chamber in the damp earth within which it undergoes metamorphosis.

In confinement if it is not provided with earth it constructs a rough cocoon of grass, frass, etc. bound together by means of silken threads. Under these circumstances however the perfect insect seldom emerges, the dry conditions which prevail appear to be inimical to its development.

After an infestation by this pest, on examining the earthen banks or "dams" which invariably surround a young rice nursery any number of these pupal cells may be discovered each containing one pupa. As many as eleven have been counted under a single small clod of earth.

Prior to pupation the larvæ remains in a quiescent condition for some two days.

PUPA.

In shape it is stoutish, the abdomen tapering to a decided point. The colour is dark chesnut brown with the spiracles and head parts marked in black.

The average normal measurements are as follows:—

Length 13.0 m.m.
Breadth 4.2 m.m.

The pupal period lasts from 9 to 10 days. The emergence of the perfect insect from the pupa case invariably takes place at night and is effected by ruptures along the lines of the wing cases. Owing to the tropical climate, generations are continuous throughout the year.

THE ADULT.

A technical description and an illustration of this moth are given by Sir G. F. Hampson in his catalogue which may, if necessary, be referred to. An excellent coloured illustration of this moth also appears in the "Moth Book" of W. J. Holland. It has been described by a number of other authors. The points given below should enable the moth to be recognised though it is somewhat similar in appearance to a number of commonly occurring species.

Two quite distinct forms are generally met with, and in equal numbers.

In the one from the fore-wings of freshly emerged specimens are of a dark reddish brown colour with a few indistinct cryptic markings the hind wings being a creamy white with a decided opalescence.

The edges of these hind wings have a thin dark marginal line accentuated at the apex which is suffused with brown. The under side of the fore-wings, abdomen and legs in some specimens exhibited a very distinct red brown colour.

The other and more ornamental form is distinguished by a whitish blotch near the apex of the fore-wings; the cryptic markings are more distinct. These variations also occur in North America. It was observed that the less ornamental forms were almost invariably females.

The average normal measurements are as follows:—

Wing expanse	29.3 m.m.
Body length	13.8 m.m.

HABITS.

As is usual with this division of the *Lepidoptera* (the *Heterocera*) the adults are entirely nocturnal in their habits, only moving in the daytime when disturbed from their resting places. When at rest they take up a position on a surface resembling their own colours and markings as closely as possible. This habit renders them inconspicuous objects and protects them from their natural enemies. They are strong on the wing though never making sustained flights; when disturbed during the daytime they fly very rapidly downwind for a short distance which makes their capture with a net no easy matter. Both sexes are attracted by lights. They are commonly met with throughout the year, the advent of the wet weather after prolonged drought causing them to appear in very greatly increased numbers.

PARASITES.

A sudden increase in the number of any particular insect or insect pest is due to the fact that conditions for its increase have suddenly become extremely favourable and that the parasite or parasites, which, under ordinary circumstances, preserve the balance of Nature have not multiplied at the

same rapid rate as their host. In this way may be explained the sudden alarming increase of certain pests and their return to normal numbers after a certain period.

In the case of the particular pest under consideration an alarming increase was observed shortly after the commencement of the rains, but in about five weeks time the parasites mentioned below increased in such numbers as to very affectively check its further ravages

HYMENOPTEROUS PARASITE OF THE GRASS MOTH.

This parasite belongs to the Parasitic Hymenoptera family *Braconidæ*. In all probability it is an undetermined species and has been sent to a specialist for a complete determination.

The larva lives inside the body of its host (which is frequently a Lepidopterous insect) either in its pupal, larval, or in rare cases imaginal form. When the larva of the parasite is fully developed it emerges from the body of its host spins a cocoon and undergoes pupation. The small white cocoons of this parasite were observed on grass blades and young rice some weeks after the first infestation of the Rice Caterpillar, and though it was suspected it was not actually proved to be parasitic on this pest till some days afterwards.

An actual case was observed of a larvæ of the parasite freshly emerged from the body of a Laphygma larvæ and commencing to spin its cocoon at the top of a young shoot. The body of the caterpillar was still adhering to the shoot and the cavity from which the larva of the parasite had escaped was plainly visible. This parasite larva was allowed to compete its metamorphosis and on the emergence of the perfect insect proved to be exactly similar to the parasites which had been bred out from cocoons previously. Observations have not yet been completed on the number of parasites emerging from each larva, time of attack, stages of existence, oviposition etc.; but it is hoped that these will be published later together with a description and the determination of the perfect insect.

APPEARANCE OF COCOON.

Length 4.3 m.m.
Breath 1.8 m.m.

In shape it is oval, closely adhering to the blade of grass and white in colour, making it a conspicuous object.

They are invariably found adhering to the tops of blades of grass, rice, etc., and at times occur in quite extensive patches.

The imago emerges through one end of the cocoon which is pushed back giving the appearance of a neatly formed lid.

The pupal stage lasts some 6 to 7 days. The perfect insect has a wing expanse of about 4 m.m. and a body length of about 2.5 m.m.

Egg parasites* undoubtedly occur, but up to the present they have remained undiscovered. Egg parasitism would prove very effective, especially as the eggs are laid in large masses.

Birds, especially the so-called "Robin" (*Leistes guianensis*), devour the larvae in great numbers.

A Coccinellid Beetle (Lady Bird Beetle) has been observed to feed on the larvae of Laphygma, especially in their earlier stages. Like the parasite it is as yet undetermined.

Eggs of this beetle were reared at the laboratoay and the young beetle larvae feed voraciously on the young Laphygma larvæ. In one instance an adult beetle was observed to destroy a cocoon of the previously mentioned Ichneumon parasite : it cannot therefore be regarded as entirely beneficial.

A species of wasp *Polistes nigriceps* also performs good work in destroying larvae.

In the United States *Laphygma frugiperda* is parasitized by several Tachinid flies and Hymenopterous parasites. A Calasoma beetle, wasps and birds are also useful. A Hymenopterous parasite (*Enicospius purgatus* Say.) and a Tachinid fly (*Archytas piliventris*) destroy 15% of the larvae of *L. frugiperda* in Cuba.

METHODS OF CONTROL.

It is unfortunate that the use of insecticides is usually entirely beyond the reach of the average native rice cultivator in British Guiana. The extremely poisonous nature of the majority of insecticides themselves alone renders their use prohibitive.

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* An insect (*Chelonus texanus*-Cres.) has been discovered in Texas depositing its eggs in the eggs of Laphygma, but the adult parasite emerges from the larva (see Journal of Economic Entomology, Vol. 5, No. 6, p. 425). A parallel case was observed by the writer in Porto Rico early in 1913.

Other methods must therefore be employed, which if conscientiously carried out will prove quite as effective. For those who are in a position to use insecticides, dry powdered lead arsenate dusted lightly over the plants will destroy the larvæ. The application can be made by sifting the poision through light cloth sacks or by means of a powder gun.

This method is the one advocated by the United States Department of Agriculture for use upon all crops grown in the South, and is claimed not to injure the foliage. Paris green used in a similar manner has a very decided tendency to scorch the foliage. A careful watch must be maintained for indications that the caterpillars are at work. On their appearance, methods for their extermination should *at once* be brought into action.

CONTROL BY FLOODING.

Undoubtedly the best and simplest method of dealing with the pest is to so construct the nursery beds as to allow of complete flooding at any time to the height of the young plants. By this means the larvæ are floated on the surface of the water and may there easily be collected and destroyed. All nursery beds for rice should be made so that any part of the bed may be easily accessible. This is accomplished by dividing it up with dams along which a person can pass. These dams will very greatly facilitate hand picking. Handpicking the caterpillars, although a somewhat tedious operation, is an effective one, and as the majority of the nursery beds are small and the operation is easily and readily performed, especially by children, it should be practised to whatever extent possible. Small perches for birds may be erected about the nursery; actual cases have been observed where these have proved of the greatest benefit. Co-operation is also an essential where a large number of plots occur together and are farmed by a number of inviduals. It is useless for a small percentage of these people to carry out remedial measures if the remaining ones allow the pest to go unchecked on their plots.

If the pest has been allowed to reach an advanced stage, *i.e.*, to pupate, the dams about the rice nursery should be beaten and well plastered down with mud so as to prevent the emergence of the moths from the pupæ which, as previously described, are to be found in the soil in this position.

Finally the ground about the cultivation should be kept as free from grass and weeds as possible. Clean cultivation plays a far greater part in the control of insect pests than is generally realised.

In conclusion it may be stated that the infestation of this pest was abnormally severe last season (1912). This is due to the fact that planting was commenced at the beginning of the rains which followed an exceedingly severe prolonged drought.

During this drought all insect life was severely checked, but as soon as the wet weather set in, it increased at a greatly accelerated rate in order, we may presume, to deal with the increased out-put of vegetation. Parasites, which under normal circumstances preserve the balance of insect life, cannot increase simultaneously owing to their parasitic tendencies. This combination of circumstances, therefore, is responsible for the universal damage done to crops last year by insects throughout British Guiana. In normal seasons the attack will not be anything like so severe.

Facts about the Sago Palm.

The colony of British North Borneo exports some £120,000 worth of sago annually.

The Agusan Valley of Mindanao could undoubtedly export several times this amount from the vast swamps filled with the same species of sago palm which extend across the Sulu Archipelago into Borneo, and eastward to New Guinea. There is no doubt that some day these swamps will be the scene of great activity in the way of starch, sugar, and alcohol manufacture.

Sago flour, when properly prepared, is an excellent food, and by fermenting, alcohol can, of course, be made. Fortunately the sago palm reproduces itself from suckers as soon as the old plant is felled; but, unfortunately perhaps for the palm-sugar maker, it is a palm which dies at the time of flowering, like the cabo negro and buri.

Properly managed, a sago swamp would be continuously productive without replanting or cultivation of any kind; that is, the growing palms should be allowed to stand at the proper distances and all unnecessary suckers and useless intermediate trunks should be removed, allowing one or two strong suckers to grow from the base of each trunk as soon as it is ready for cutting. In fact, the sago may some day rival the nipa as a profitable palm crop, though it will never compare with the coconut.

—"Agriculture Review," Philippine, June, 1912.

Hevea Seeds.

By T. Petch B.A., B.Sc., Government Mycologist, Ceylon.

WHEN Collins wrote his "Report on the Caoutchouc of Commerce" in 1872, he suggested that Hevea seeds should be sent packed in sugar to ensure their germination on arrival. Whether that method was ever adopted has not been recorded. Apparently it was not. The first consignment of Hevea seed received at Kew was sent in a barrel, and out of 2,000 seeds only 12 germinated.

The first demonstration that Hevea seeds could be sent safely through the post, if properly packed, was given by Trimen, who in 1894 recorded that 200 had been sent to Kew from Ceylon in that year, everyone of which germinated after being one month in transit. For some years after that, both Ceylon and Singapore favoured Wardian cases of plants, instead of seed, for transmission abroad; but the practice has now settled down to packing in charcoal and forwarding by parcel post, the chief essentials being that the seed should be packed fresh and in small quantities, not more than about 500 in a tin.

During the last few years, several instances have been recorded in which the germinative capacity of the seed has been retained for a period which ten years ago, would have thought incredible. The late J. K. Nock, in the Report of the Royal Botanic Gardens, Peradeniya, for 1908, stated that on August 25th, 1,500 seeds, packed in charcoal and coir dust, slightly damped, in biscuit tins, were forward to India, but as the consignee could not be found they were returned to Ceylon on November 4th, seventy-two days after despatch. They were immediately sown in an open bed, and 496 plants were raised, the last seed germinating on December 20th, or 144 days after gathering; this number would probably have been exceeded had not the bed been visited by porcupines a week or two after germination had commenced. These seeds therefore gave a germination of 33 per cent. after being packed for 72 days.

Spring, of the Federated Malay States, has recently recorded a similar occurrence of longer duration. Six hundred seeds were packed in layers of burnt rice husk, in a box 12 x 8 x 5 inches, which was wrapped up in canvas ready for despatch on January 31st; but as the customer had forgotten to leave

his address they could not be forwarded. On July 13th, 5 months and 13 days afterwards, the tin was opened and left near a window, and 53 seeds germinated. One hundred others were then sown in a pan, and three more plants were produced. As the lower layer would not be likely to have much chance of successful germination the probable percentage germination is much higher than the figures indicate.

AN ELEVEN MONTHS RECORD.

Another instance of prolonged vitality has just been noted at Peradeniya. On September 25th, 1911, 300 seeds were packed in layers of charcoal and coir dust in a tin which was wrapped in canvas in the usual way. On August 17th, 1912, the tin was opened and the seeds sown in pans, with the result that 117 germinated and produced plants by September 25th, 1912. The seeds were planted too thickly in the pans, and with less opportunity of contact with decaying seeds a few more might have germinated. However, as it stands, 39 per cent., germinated after being packed for nearly eleven months.

Experiments to test the relative vitality of seed from tapped and untapped trees were carried out at Peradeniya in 1907. A sample of seeds from a consignment just about to be exported was sent in for report, and the subsequent experiments with Peradeniya seed were undertaken primarily to determine whether the weight of the seed gave any criterion as to its germinative capacity. Consequently, the seeds were kept under conditions which approximated to ordinary estate practice. As stated in the circular on the subject, they were kept in open dishes in the laboratory: they were not packed in charcoal or preserved in any way. The results showed that the seed from the tapped trees retained their vitality longer than the seed from the untapped trees. Similar experiments have been carried out by Spring, but with the seeds packed in charcoal, as for export, in tins each containing 200 seeds. Under these conditions, the seed from untapped trees showed a greater percentage of germination during the period of the experiments (10 weeks) than the seed from the tapped trees. Seeing that the conditions were altogether different, a different result is not so surprising. It would be interesting to have a repetition of the two experiments on the same samples of seed to ascertain whether the difference is really due to the manner in which the seeds were kept. Unfortunately, Spring made no preliminary test of the germinative capacity of his seeds;

and his figures would seem to show that his seed from tapped trees was originally of bad quality. The percentage germination after being packed three weeks was only 33. Considering that the bulk of the Hevea seed sold is from tapped trees it would seem evident that the usual percentage germination is greater than that.

THE WEIGHT OF HEVEA SEEDS.

Information with regard to the weight of Hevea seed is gradually approximating to uniformity, and it is becoming more and more evident that the discrepancies between previous accounts were due in some cases to errors of experiment and in others to abnormal samples. Carruthers weighed a small number of seeds at Peradeniya, and subsequently published his results in the "Agricultural Bulletin of the Straits," etc.; he found that 414,000 seeds would be required to yield a ton of kernels, but the seeds were weighed fresh and nc allowance was made for drying.

Experiments in Ceylon in 1907 showed that, in round numbers, 700,000 seeds would be required to furnish a ton of kernels, but actual trials on estates have proved that with unsorted seed from regularly tapped trees the number is about a million. In the F.M.S., Lewton Brain has recently made experiments which lead him to deduce that the number required will be about 533,000. The weight of 1,000 fresh seeds was 8 lbs. 6 ounces, the weight of the shells alone being 3 lb. 2 oz.; this gives a total of 426,700 seeds required to produce a ton of fresh kernels, and allowing 20 per cent. for loss on drying brings the number required to 533,000.

In the Ceylon determination, the weight of 1,000 fresh seeds was assumed to be 8 lbs. As the F.M.S. determination was based on seeds weighing 8 lbs. 6 ozs. per thousand, that would account for a difference of about 10 per cent. in the estimates. But another difference arises from the fact that Lewton-Brain assumes that the loss of weight on drying is 20 per cent. of the kernel, whereas the Ceylon figures show that it is 20 per cent. of the whole seed, and the shell loses very little.

The weight of a single Hevea seed, of course, varies enormously, but over a series of large samples the average weight works out fairly constant, and the figures now available show that there is not that difference between the Hevea seed of different countries which was once supposed to exist. At Peradeniya, fresh seeds weigh on the average about 3.75 grams,

but one tree this year has produced seed which average 7.1 grams. Further, a tree on the neighbouring estate, planted in tea, has borne seed which averages only 2.75 grams, and the smallest weight recorded for an individual seed (fresh), in Ceylon, is 1.2 grams. Vernet, in 1908, recorded that Hevea seed in Annam varied from 1.02 to 9.55 grams each, and he somewhat astonished other countries by stating that seeds weighing less than 5 grams each should not be used for planting; but he has since withdrawn that recommendation because he found it impossible to obtain any large number of seeds of the desired weight.

"SPRING" AND "AUTUMN" SEEDS.

It is sometimes stated that in Ceylon two crops of seed are obtained in the course of the year. In a certain sense, that is correct, but the deduction frequently made by writers, in other countries, that the same trees fruit twice in the year, is not. On the Western side of the island where rain falls normally during both monsoons, the trees flower in February–March, and bear seed in July–September. But on the eastern side, where rain falls only during the North–East Monsoon, October–January, the trees fruit in December-February. The fruiting period of Hevea, and practically all fruit trees, *e.g.*, mango, differs by six months on the two sides of the Island. But each tree only bears fruit once. An interesting case was observed this year on an estate which, though subject only to the North-East rains, lies at the foot of the range of hills which divides the two regions. In March last, seed was falling from the trees on the slopes, i.e., their phase was the normal one for that side of the Island. But in one field, where a small stream ran at the foot of the slope, the trees on the slope were seeding while those along the stream were shedding their leaves, *i.e.*, the latter was in the same physiological condition as the trees on the western side of the Island. There was thus six months difference between trees not more than a hundred yards apart. Similar phenomenal have been recorded for Singapore, where, apparently, some trees may be found in fruit at any time of the year. Whether any tree fruits twice in the course of the year at Singapore has not been recorded, nor have the differences between the various trees been correlated with their environment.

"Tropical Agriculturist," (Ceylon), Nov., 1912.

The Egg Parasite[1] of the Small Sugar Cane Borer.

By G. E. Bodkin, B.A., Dip. Agric. (Cantab), F.E.S., F.Z.S.
Government Economic Biologist.

INTRODUCTORY.

Of the several parasites that are known to attack the Small Sugar Cane Borer (*Diatræa saccharalis* and allied species) during the different stages of its life history in British Guiana, by far the most effective is the tiny parasite that deposits its eggs, by means of its sharp ovipositor, within the eggs of the Borer itself. These eggs hatch out into minute grubs which live upon the contents of the Borer eggs and eventually emerge as the adult winged parasite. These adults are small insects only just visible to the naked eye, but on magnification they will be seen to be light yellow in colour with bright red eyes and sensitive 'elbowed' antennæ or 'feelers'. The males are distinguished from the females by their somewhat smaller size and by their anntenæ bearing conspicuously long hairs.

An examination of the literature on the subject shows that this parasite has been observed to attack the eggs of *Diatræa saccharalis* for a number of years in the British West Indies, and the writer has personally observed instances of its attack in this connection in Trinidad, Barbados, Porto Rico,[2] and also Louisiana, U.S.A.[3] W. Van Deventer also describes[4] the appearance and habits of what must be a closely allied species in Java, under the name of *Chætosicha nana*.

Its first appearance in this rôle in British Guiana is not recorded, though the moth borer is known to have been present in the canefields for the last thirty years.

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[1] Examination of this tiny insect shows that it is closely allied to—or identical with—the well known *Trichogramma pretiosa*, Riley Specimens of both sexes from various localities in British Guiana have been forwarded for examination to Mr. A. A. Girault, the authority on the genus, who is at present in Australia.

Throughout this article, and till the more exact determination comes to hand it will be termed *Trichogramma* sp.

[2] Mr. Girault has recently examined the Trichogramma—like parasites of *Diatræa* eggs from Porto Rico and has pronounced them to be *Trichogramma minutum* of Riley (= pretiosa).

[3] Louisiana Sugar Planter, December 28th, 1912.

[4] Handboek ten dienste van de Suikerriet-Cultuur en de Rietsuiker-Fabricage op Java. Tweede Deel. De dierlijkevijanden van het suikerriet en hunne parasieten. W. Van Deventer. p. 139 Plate 20,

At present it is distributed over all the cane growing areas in the colony, in fact everywhere where the small moth borer is to be found. Parasitized eggs of Diatræa have been on several occasions observed on razor grass and rice, which plants the Borer also attacks. The characteristic blackened appearance of parasitized egg masses renders them conspicuous objects in comparison with unparasitized ones and owing to this fact the percentage of parasitism is apt to be overestimated.

A closely allied or similar parasite is also known in other parts of the world as an enemy of ~~other~~ insect pests such as the Cotton Boll Worm (*Heliothis obsoleta* Fabricius) [5] and the Brown Tail Moth (*Euproctis chrysorrhœa*) [6] in the United States.

As far as can be ascertained no extended investigations [7] have been previously made on the habits and life history of this insect when attacking the eggs of *Diatræa saccharalis*. Detailed observations on the emergence from the egg, copulation, proportion of sexes, etc., of a closely allied or similar parasite when attacking the eggs of the Cotton leaf worm (*Alabama argillacea*) have been published [8] however by Arsène Girault which in many points agree closely with the habits of *Trichogramma* in British Guiana.

The following observations and experiments on the life history, habits, and economy of this parasite were made by the author in the Biological Laboratory of the Department of Science and Agriculture. Mr. L. D. Cleare, jnr., ably assisted the writer in making a number of the observations.

The material for study was obtained principally from Plantations Non Pareil, Anna Regina, Lusignan and Uitvlugt.

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[5] Bull. No 50, Bureau of Entomology, U.S. Department of Agriculture. 'The Cotton Boll Worm' by A. L. Quaintance and C. T. Brues. 1905 pp. 118, 119. Figs. 20 and 21.

4th Report of the U.S. Entomological Commission by C. V. Riley Washington 1885. p. 102.

[6] Bull. No. 91. Bureau of Entomology, U.S. Department of Agriculture. "The Importation into the U.S. of the Parastics of the Gipsy Moth and the Brown Tail Moth" by L. O. Howard and W. F. Fiske. p.p. 256-266, Fig. 57.

[7] A brief account of the parasitism of ***Diatræa*** eggs by a Trichogramma-like insect was published in Demerara by J. J. Quelch in his interim Report on Insect Pests' April 1911.

[8] Journal of N.Y. Entomological Society Vol, XV., p.p. 57-60 and p.p. 117-120 Psyche. Vol. XIV., p. 80-85.

REARING THE PARASITE UNDER LABORATORY CONDITIONS.

Black parasitized egg masses were collected in the field. brought into the laboratory, and placed in small clear glass tubes 5 c.ms. in length and 1 c m. in diameter; the ends or these were then plugged with cotton wool. The emergence, copulation tion, etc., of the parasites could thus readily be observed by means of a powerful hand lens. Oviposition was observed by placing in one of these small tubes Diatræa egg clusters of a known age deposited by female moths bred from pupæ in confinement and known to have been fertilized. A female *Trichogramma*, recently emerged and fertilized was then introduced. The movements of a parasite in the tube may be guided to certain extent by exposing certain parts to the light and covering up the others, as these insects are always attracted towards the source of light. For instance, if the bottom of the tube is pointed to the light the plug of cotton wool may safely be withdrawn without danger of the contained parasites making their escape.

EMERGENCE FROM THE DIATRÆA EGGS.

Under laboratory conditions emergence invaribly commences between 5 and 5.30 a.m. and continues for a number of hours. In the field on one occasion parasites were observed to be still emerging from an egg mass at 9 a.m.; the greater number however had already made their way out and left.

The contained parasites commence to bite out a hole in the enveloping *Diatræa* eggshell some hours previous to emergence and soon a tiny, light coloured, roughly circular patch, visible on the surface of the egg indicates where the confined insect is at work. As a general rule only one emergence hole is made in each egg, all the contained parasites emerging from the same hole. Occasionally however two emergence holes are made and this as a rule when five parasites are contained in the same egg. In several cases where the entire egg mass had become detached from the surface of the leaf the emergence hole was made on the under surface of the egg.

On emergence the wings of the parasites appear damp and crumpled though the insects are capable of active movements. The wings are smoothed out by means of the hind legs and the antennae are cleaned by means of the front pair of legs. The wings are perfectly dried and ready for flight some ten minutes after emergence. A small quantity of waste larval product is excreted soon after emergence.

NUMBER OF PARASITES PRODUCED FROM EACH EGG.

The maximum number of parasites capable of developing in one *Diatræa* egg is five. Occasionally only one is produced. From a large number of observations the more usual number appears to be three. Some Trichogrammas appear to oviposit more systematically and consequently more effectively than others. The diagrams accompanying this article demonstrate this point.

PROPORTION OF SEXES.

From careful examination of the parasites emerging from a large number of egg masses from different localities the average proportion of females to males appears to be 10 to 1.

ACTIVITY OF ADULTS.

These parasites are extremely active insects, and will crawl at a rapid rate over smooth surfaces. They easily get entangled, however, and cases were repeatedly observed where a parasite had got hopelessly entangled in the cotton wool used to plug the glass tube in which the parasites were confined. Their powers of flight, for such a small insect, are remarkable; but not being capable of sustained flight, they make short darting flights from one object to the other. Moisture if present on the sides of the tube will quickly entrap the wings of the parasites, from which they seldom escape. A marked decrease in temperature causes the adults to become sluggish.

COPULATION.

In the laboratory this was seen to take place immediately after emergence. The males are usually among the first to emerge and never move far from the egg mass but are occupied in continued movements about the eggs, stopping every now and then to inspect, by means of their antennæ, the spot where a parasite is slowly making its emergence. Whenever a female is detected the male constantly returns to this same spot and in some cases assists her by means of his forelegs in getting clear of the egg. Copulation takes place as soon as this is accomplished, the act lasting from 8 to 10 seconds. Two, and in some cases three males often struggle violently among themselves for the possession of one female, all three eventually copulating. During the sexual act the wings of the male are held upright and quite motionless. The males on emergence at once com-

mence their search for the females, even before their wings have dried. Copulation continues for some time after the emergence of all the parasites. The females thus seldom, if ever, escape fertilization.

PARTHENOGENSIS.

In the United States it is a known fact that *Trichogramma* is capable of reproducing parthenogenetically *(i.e.,* without being fertilized by a male,) in the eggs of the Cotton Boll Worm (*Heliothis obsoleta.* Fabr) and the Brown Tail Moth (*Euproctis chrysorrhoeu*). To test whether this fact also applied to *Trichogramma* sp. in British Guiana when parasitizing the eggs of *Diatrœa saccharalis* under laboratory conditions, female parasites from egg masses taken in the field were isolated immediately on their emergence without having been fertilized by a male. These were supplied with fresh egg masses of *Diatrœa,* according to the previously described practice, which they at once commenced to parasitize. These eggs began to show signs of parasitism some three days after oviposition and in 9 days parasites emerged as shown by the accompanying table. On inspection all of these parasites proved to be males.

The small number of the experiments carried out are not sufficient to show whether this is always the case but the results agree with similar experiments made in the United States with *Trichogramma* when reproducing parthenogenically in the eggs of the Brown Tail Moth. These resulted after some 275 separate but similar experiments in the invariable production of male progeny.*

Egg Mass.	*Number of Eggs.*	*Date of parasitism.*	*Date of emergence.*	*Number of parasites produced.*	*Sex.*
A	11	22. iv. 13	1. v. 13	45	All Males.
B	16	22. iv. 13	1. v. 13	38	,,
C	16	22. iv. 13	1. v. 13	73	,,

* Bull No. 91, Bureau of Entomology, U.S. Department of Agriculture 'The importation into the U.S. of the parasites of the Gipsy Moth and Brown Tail Moth. By L. O. Howard and W. F. Fiske pp. 257-258.

DIAGRAM 1.

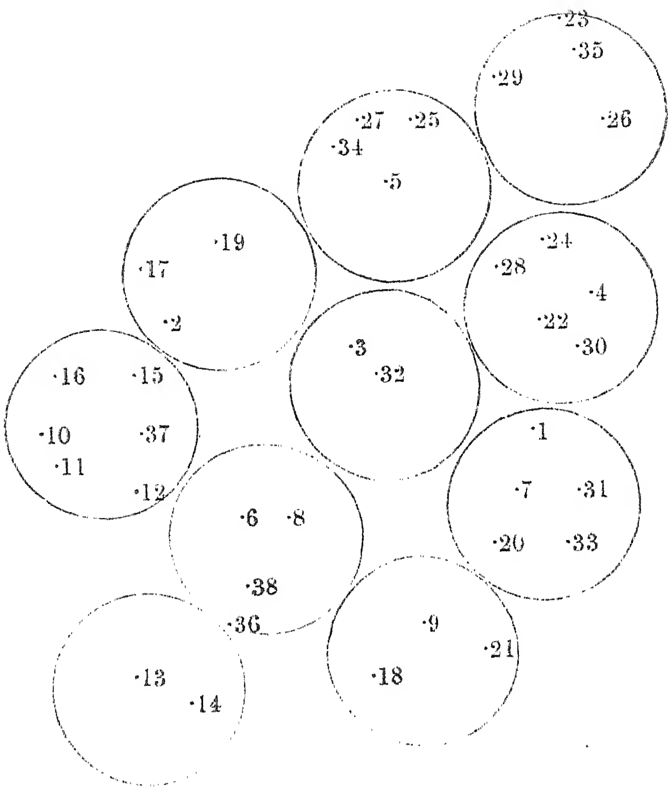


DIAGRAM showing the oviposition of *Trichogramma* sp. in the eggs of *Diatræa saccharalis* under laboratory conditions. The circles represent the eggs of the moth as deposited (diagrammatic, as they are greatly enlarged and in reality are oval in shape and overlap slightly). The numbers indicate the order in which the ovipositions took place. A freshly emerged and fertilized female parasite was used. She oviposited 38 times taking one hour and twenty minutes for the process. The temperature rose from 80°-84° F. during the period. After 9 days 36 parasites emerged. 3 of which were males and 33 females.

DIAGRAM 2.

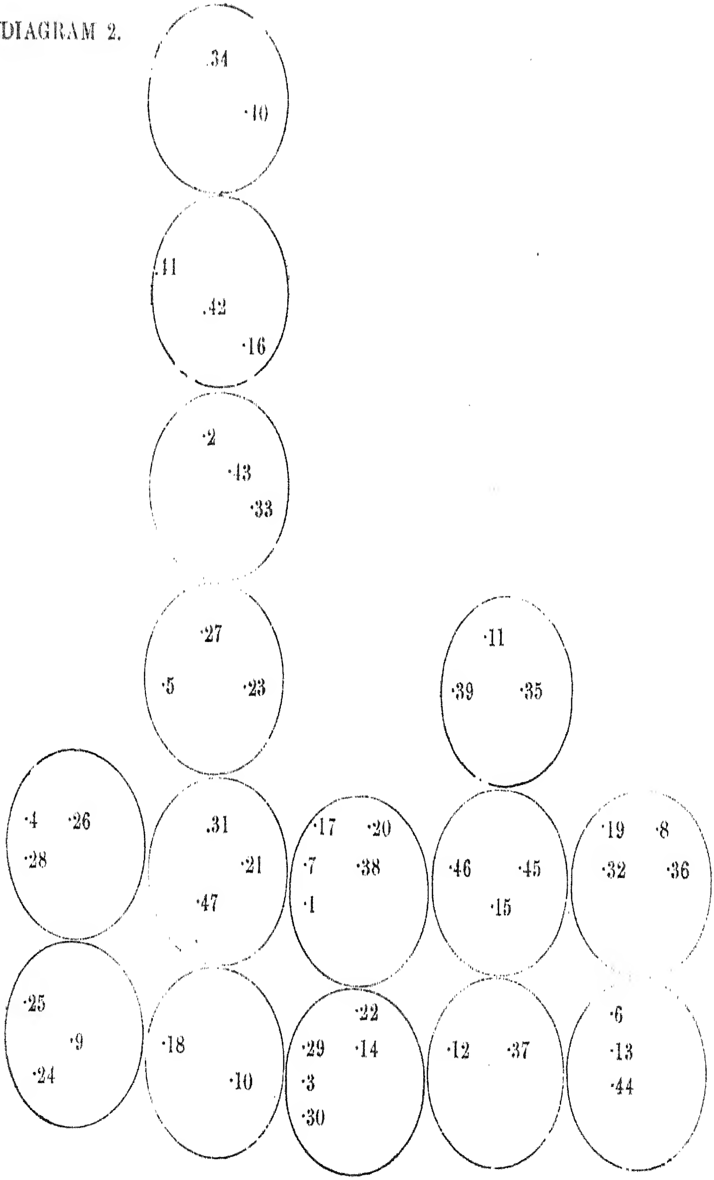


DIAGRAM showing the oviposition of *Trichogramma* sp. in the eggs of *Diatræa saccharalis* under laboratory conditions. The circles represent the eggs of the moth (diagrammatic as they are greatly enlarged and in reality are oval in shape and overlap slightly). The numbers indicate the order in which the ovipositions took place. A freshly emerged and fertilized *Trichogramma* was used. She oviposited 47 times taking one hour and fifty minutes in the process. Temperature rose from 80°-84° F. during this period. After 9 days 45 parasites emerged, 4 of which were males and 41 females.

which are poisonous to the bacteria causing decay. Borax, formalin, and carbolic acid are used in different cases to prevent decay—they are germ poisons Lastly, crops cannot grow in soils too salty because the soil water has too much dissolved matter—it is too strong a solution—to pass into the roots by osmosis. It is for this reason that putrefactive germs cannot work in meat that has been made too salt for them; and also why jam and preserves keep all right when enough sugar has been used in the making. Altogether, the many and different methods of preventing putrefaction and decay all have the same immediate object—it is to render the conditions of life unfavourable to the growth of the little plants which cause the damage.

—J. W. Patterson, B.Sc., Ph. D. in "The Journal of Agriculture," Victoria, Australia.

The Origin of Tuberculous Infection.

It is difficult to avoid the logical conclusion that the mechanism of infection in children as in adults is in the main by way of the respiratory tract.

Children may become infected primarily by way of the intestine but there are many possibilities in addition to those afforded by infected food. Thus dirty fingers contaminated with floor dust and particles of dried sputum containing tubercle bacilli are immediately carried to the mouth of a child; or a tuberculous mother moistens with her lips the child's rubber "comforter" and bacilli are thereby conveyed to its intestinal canal.

Milk may be and no doubt is an occasional source of tuberculous infection but the importance of giving attention primarily to cows' milk rather than to other hygienic measures for the prevention of consumption is undoubtedly over-rated.

No effort should be relaxed which will serve to promote the provision of a pure milk supply from well-ordered dairies and clean, well-ventilated, well-lighted cow-sheds; at the same time the enormously greater probability of infection from human sources, particularly from cases of pulmonary tuberculosis; cannot be exaggerated.

After all, to struggle against tuberculosis by means of measures such as are now employed or foreshadowed by legislation is at best a hopeless task. The evolution of man

and of the tubercle bacillus on mutually antagonistic lines seems likely to proceed till the end of time; only by the gradual establishment of natural immunity, built up step by step by successive generations who have successfully sustained its attacks, can freedom from the disease be at last attained.

Paradox though it may seem to be, by lessening the general risk of infection of the community, the proposed isolation of persons suffering from tuberculosis may actually retard rather than assist the struggle against consumption.

What can and should be done is to place all individuals from birth onwards under conditions most conducive to the maintenance of good health, so that they may encounter infection successfully, remembering always that overwork and underfeeding are the surest preparation for the disease.

It is not impossible that the compulsory notification of tuberculosis may have an effect perhaps undreamt of by its promoters. The unfortunate patient branded as consumptive, on the insufficient evidence afforded by the present means of making a certain diagnosis, may find himself in the position of a leper—more surely isolated by the natural fears those who encounter him may have of incurring the disease than by all the sanatoria that can be devised.

So far as children are concerned,* the boiling of milk may safely be regarded as of secondary importance so long as windows are kept open and floors frequently scrubbed.

—R. R. Armstrong, B.A., M.B., B.C. (Cantab), M.R.C.S., L.R.C.P.
(Registrar, Hospital for Sick Children, Great Ormond Street, London) in "Science Progress" January 1913.

The Human Race and the Tubercle Bacillus.

THE people of Northern Europe have been subjected to a very stringent selection as regards tuberculosis during several thousand years; the selective process has become more stringent of late years in proportion to the increase in the town population. At the present time it is so stringent that probably every individual in Northern Europe, living in a town or even in a village, is infested with tubercle many times during life. I do not mean merely that the tubercle bacillus

* In England.—(ED.)

gains access to his body and is immediately eliminated but that it becomes established therein and multiplies, being eliminated only after some time. The evidence that this happens is overwhelming. Thus Ribbert has published the record of 5,000 consecutive post mortem examinations of cases that died in general hospitals. Traces of tuberculosis were found in every one of these cases. In all similar records of which I know, the lowest percentage of cases in which traces of tuberculosis have been detected is seventy-five. It has also been shown that very frequently the signs that are met with of tubercular disease of the lungs of long standing indicate very considerable and extensive damage and destruction of tissue, not a slight infection; yet such individuals have recovered from the disease and this has no permanent effect upon their health. Now it is well known that when the tuberculosis bacillus is introduced among a race which has had no previous experience of the disease many individuals contract the disease and die of it rapidly under conditions which would bring about a cure in susceptible European patients. The explanation of this fact is quite simple. The relative immunity of the European has been brought about by a process precisely similar to that described of the deer and the carnivora. When the tubercle bacillus first appears, the different individuals of the races will differ in their susceptibility to its ravages, just as they differ in other characters. The least susceptible will have an advantage over the more susceptible and have a greater chance of producing and rearing children. Taking the average resistance of the race originally as 0, some of the individuals will have a greater resistance than the average and these may be classed as +1. Others will have less;—these will be −1; others will be 0. In the next generation, however, more children will have been produced and reared by the +1 individuals. Offspring inherit their parents' characters with variations but this second generation will vary from a new mean, +1; some individuals will vary towards a greater, some towards a less and some will inherit the character in the same degree as their parents. We shall, therefore, have a generation of individuals consisting of 0, +1 and +2. Obviously, the +2 class will have the greatest chance of surviving and rearing children, so the next generation will vary again from a higher mean, +2. This process must continue as long as the tubercle bacillus continues in the environment, until a very high degree of immunity is attained by the race. Of course, variations away

from the average of racial immunity must continue to appear but the standard of the race is maintained because these unfavourable variations are eliminated. There is undoubted evidence that tuberculosis existed in Egypt about 5,000 years ago, so it is practically certain that it occurred also in countries further north which had communication with Egypt at any rate indirectly, where the conditions are as favourable to the tubercule bacilus as they are unfavourable in Egypt. Northern Europeans have therefore been subjected to selection during several thousand years; hence comes their comparative immunity.

It is unfortunately inconceivable that the tubercle bacillus can be eliminated altogether. It is able to survive in a dried-up condition during a very considerable period of time and it is probable that the inhalation of dried tubercle bacilli is a common cause of pulmonary tuberculosis in the case of susceptible individuals. Besides this, tuberculosis is probably as common in cattle and perhaps other animals as it is in man. If even in spite of this wide distribution, the bacillus were eliminated in the British Isles, it is inconceivable that its introduction from abroad could be prevented. Therefore, if susceptible individuals are kept alive and allowed to breed in large numbers we must expect serious ravages in the future, when the racial standard has been lowered and a temporary concatenation of circumstances favours the infection of a large number of individuals at the same time. The nation whose racial standard is thus lowered by legislative interference must eventually be supplanted by an invading race which has continued to exist under conditions of stringent selection. Under invasion I intend to include simply the immigration of immune individuals.

—Dr. Charles Walker, D.Sc., M.R.C.S., L.R.C.P.
in "Science Progress," January, 1913.

The Oil-Palm under Cultivation.

The Oil-palm (*Elæis guineensis*) lends itself admirably to cultivation, and when its improvement by selection and better cultural methods is properly understood, resulting in larger yields and returns, we shall have with palm-oil as we have with rubber the competition between the "plantation oil" and the "wild oil" on the various distributing markets of the world.

—"Tropical Life," February, 1913.

Answers to Correspondents.

G. R. G. (Georgetown).—The caterpillars destroying the grass on putting greens at the Golf Course are those of *Laphygma frugiperda*, S. and A. The pest is wellknown both in North and South America and in the West Indies as a serious pest of Indian Corn, Sugar Cane, Rice, etc.

P. K. (Botanic Gardens).—The two larvæ feeding on Sugar Cane blades were those of *Caligo oberon*—a common insect pest among canes and plantains. The Insects you sent in are as follows :—

Host Plant : *Myrtus communis* Insect : *Thrips rubrocinctus.*

,, ,, : *Areca catechu* Insect : A new Sp. of *Aspidiotus.*

, ,, : *Chrysoledocarpus lutesces* Insect : *A. destructor* and *Ischnaspis filiformis.*

,, ,, : *Archontophœnix Cunninghami* Insect : *I. filiformis.*

A. A. A. (North West District).—The moths you sent in as reared from Wild Potato belong to the family *Syntomidæ* and are *Syntomeida melanthus.* The larvæ feeding on the locust are probably those of a *Tachinid* fly—a family is known for its parasitic habits. The biting flies you sent in are quite new to us—the brown and black ones belong to the genus *Chrysops* while the black ones are *Tabanids.* They have been sent to a specialist for identification. The larva feeding on the Cacao leaves is a *Limacodid.* The moth has not yet emerged so identification is not at present possible.

Lady E. (Georgetown).—The specimen forwarded is a "Bag worm" probably *Oiketicus kirbyii.* The male moth is a small, dull coloured insect, the female is wingless and never leaves the 'bag' which is composed of bits of twigs spun together.

E. M. M. (Botanic Gardens).—The "grubs" you sent in attacking decaying cane were the larvæ of a *Rhyncophorus* beetle, probably *R. palmarum*

A. A. A. (North West District).—Specimens received :—

2 Orthoptera, 2 Hymenoptera, 13 Coleoptera, 8 Lepidoptera, and 8 Homoptera.

Soil Losses by Drainage.

Phosphoric acid, potash, lime, and nitrogen are the soil constituents which the farmer wishes to conserve, and each of them stands in a different relation to drainage losses. A discussion of the subject and the analysis of drainage waters from the fields of fire farms appeared recently in the *Illustrated Landw Zeit*, which serve to draw attention to the subject. The results were typical. There was no phosphoric acid lost by drainage. The loss of potash was not serious, but there was considerable loss of nitrogen (11.8 parts per million) almost wholly as nitrates. There was no loss of nitrogen as ammonia. The most serious loss was in lime, amounting to 215 parts per million. In nearly all cases lime will be the chief constituent in drainage waters. The loss is greater on cultivated land than on pasture, and most of the manures in use tend to increase it. The waste is inevitable, and in the long run must be made up by fresh applications of lime at the surface.

—Journal of Agriculture, Victoria, Australia, November 11, 1912.

How to cause the Banana to set Seeds.

The following directions for causing a banana to produce seeds were given the writer by a Porto Rican native, who was unquestionable a banana culture expert: Get a stool of bananas growing rapidly in shallow soil by the addition of artificial fertilizers; let one bunch of fruits "set," but before that ripens cut down all but one of the stems in the clump; the remaining shoot, "thinking it has but one more chance to perpetuate its kind before being killed" on account of the tremendous shock to the more or less connected stem bases in the clump, at once produces a small bunch of somewhat abnormal fruits some of which will contain genuine seeds. As a matter of fact, it is a usual thing to find seeds in the commonest of the Philippine bananas, the Sabá. This phenomenon has a really great value in the study of musology for it permits us to believe that the vast number of distinct varieties in existence to-day are not necessarily "sports" from shoots of some ancestral type of by-gone ages.

—"Agricultural Review," Philippine, July, 1912.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods, setting out the number of pupils who attended the Model Gardens of the colony from April 1, 1907. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to March 31; April 1 to June 30; July 1 to September 30; and October 1 to December 31. The totals only during 1907, 1908 and 1909 are given; the records since then are in detail.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1907.										
2nd to 4th	1,261	928	994	835	556	...	...	...	...	4,574
1908.										
1st to 4th	5,447	3,386	1,477	887	1,053	160	...	...	...	12,410
1909.										
1st to 4th	6,473	2,665	1,738	1,277	1,192	1,897	662‖	...	...	16,904
1910.										
First	1,282	769	287	370	259	489	465	..	...	3,921
Second	1,311	558	787	894	303	455	519	403§	...	5,240
Third	¶1,234	526	910	748	294	510	498	537	...	5,257
Fourth	1,209	444	1,285	336	295	493	502	592	...	5,156
1911.										
First	1,086	360	1,042	838	312	514	414	572	577	5,695
Second	1,263	326	713	816	286	292	536	591	688	5,511
Third	¶1,093	385	910	627	361	297	543	441	639	5,296
Fourth	1,687	448	935	588	447	406	737	957	540	6,745
1912.										
First	1,127	379	1,374	1,034	425	207	573	359	423	5,901
Second	1,385	359	1,096	900	484	553	730	461	413	6,381
Third	1,416	400	763	889	412	572	621	616	443	6,132
Fourth	1,586	254	1,162	479	459	768	620	720	439	6,487
1913.										
First	1,613	464	1,060	637	529	764	661	464	342	6,534

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

¶ Schools in vacation during August.

‖ Instruction commenced in July.
§ Instruction commenced in April.

Exports of Agricultural and Forest Products

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to March 30th, 1913. The corresponding figures for the three previous years are added for convenience of comparison :—

Product.	1910	1911	1912.	1913
Sugar, tons ...	20,000	13,866	15,252	13,855
Rum, gallons ...	575,652	331,639	902,210	942,333
Molasses, casks ...	445	179	650	505
Cattle-food, tons ...	2,131	2,020	1,566	2,830
Cacao, cwts. ...	118	59	.5	...
Citrate of Lime, cwts.	70	...	...	...
Coconuts, thousands	115.5	216	716.5	263
Copra, cwts. ...	65	425	710	329
Coffee, cwts. ...	344	269	469	509
Cotton, lbs. ...	...	...	...	...
Fruit, brls. and crates	...	...	...	...
Ground Provisions, value	$16 00	...	...	...
Kola-nuts, cwts. ...	...	...	...	...
Rice, tons ...	1,650	701	1,136	1,181
Rice-meal, tons ...	460	124	531	705
Starch, cwts. ...	...	...	...	...
Cattle, head ...	259	181	141	177
Hides, No. ...	1,362	1,414	722	1,549
Pigs, No. ...	266	196	242	544
Poultry, value... ...	$ 16 68	...	...	..
Sheep, head ...	6	18	6	4
Balata, cwts. ...	488	647	212	1,928
Charcoal, bags ...	17,612	17,778	18,544	14,809
Firewood, Wallaba, etc., tons ...	2,166	2,557	2,817	2,191
Gums, lbs. ...	192	787	446	1,332
Lumber, feet ...	32,182	104,321	46,073	66,611
Railway Sleepers, No.	...	1,000	1,556	1,503
Rubber, cwts. ...	7	4	1	.4
Shingles, thousands	380	929	207.5	703
Timber, cubic feet	78,451	58,096	63,286	124,038

Selected Contents of Periodicals.

The Spotting of Plantation Para Rubber.

(By C. K. Bancroft, M.A., F.L.S,)

The Preparation of Plantation Para Rubber.

—Bulletins of the Department of Agriculture,
F. Malay States.

Mechanism of Infection in Tuberculosis.

Horticultural Research II. Tree Pruning and Manuring.

—"Science Progress," No. 27 : Jan., 1913.

Explosives in Agriculture.

Conference of Coconut Planters (Ceylon): Address by the Director of Agriculture.

—"Tropical Agriculturist," Ceylon, Jan., 1913.

Anthracnose of Sisal Hemp.

Drainage and Rice Soils.

—"Agricultural Journal of India," Jan., 1913.

Tuberculosis of Food Animals and its Relation to the Public Health.

Teff (Eragrostis abyssinica).

—"The Agricultural Journal of the Union
of South Africa," Jan., 1913.

A Mosquito, Frog and Dirt-proof Rainwater Tank.

Vegetables in Tropical Queensland.

The Pomelo: Grape Fruit or Shaddock.

—"Queensland Agricultural Journal," Feb., 1913.

DIAGRAM 3.

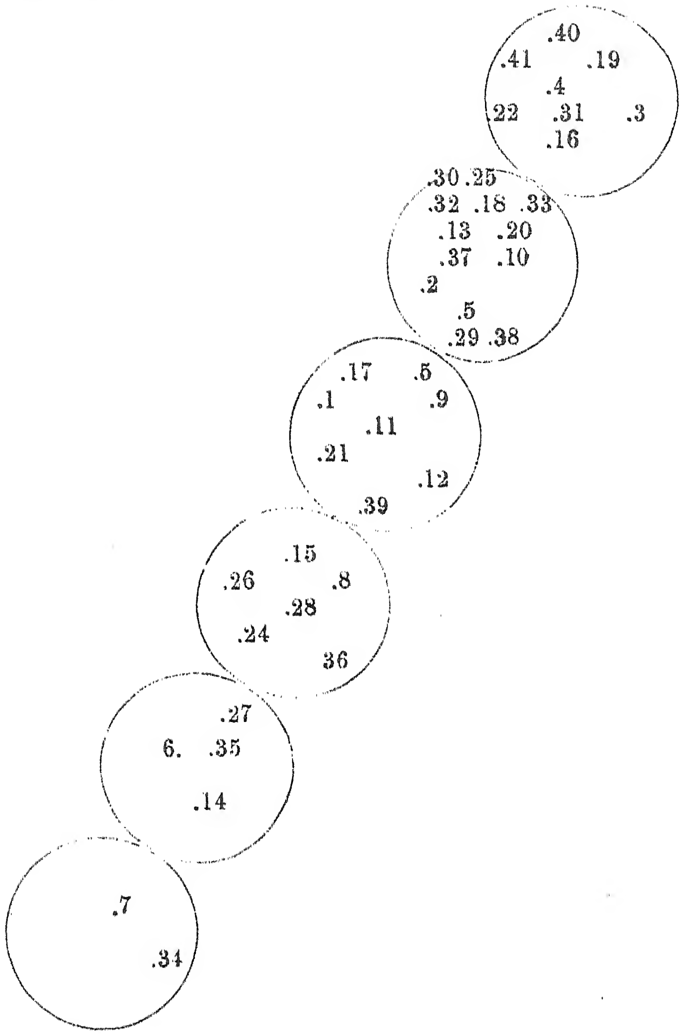
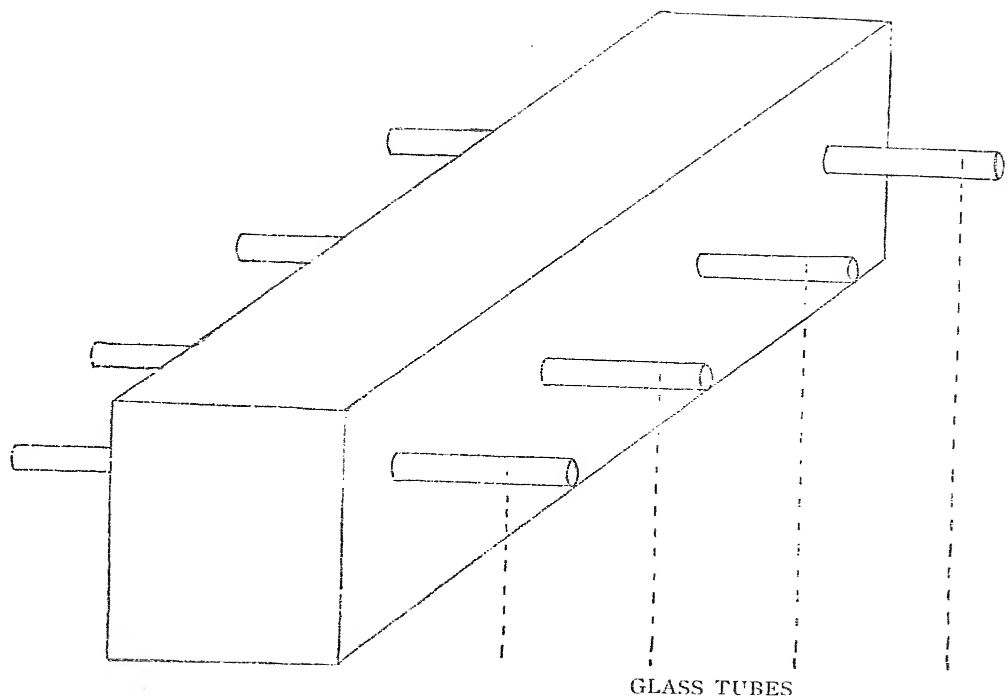


DIAGRAM showing the oviposition of *Trichogramma* sp. in the eggs of *Diatræa saccharalis* under laboratory conditions. The circles represent the eggs of the moth as deposited (diagrammatic as they are greatly enlarged and in reality are oval in shape and overlap slightly). The numbers indicate the order in which the ovipositions took place. The same female parasite was used as in Diagram 2. She oviposited 41 times taking one hour and 57 minutes in the process. Temperature rose from 84°-86° F. during this period. After 9 days 26 parasites emerged, 3 of which were males and 23 females.

DIAGRAM 4.

Parasite Rearing Box.



Owing to the capable and efficient manner in which the males perform their sexual duties it is extremely doubtful whether parthogensis ever takes place under natural conditions, and the fact may therefore be regarded more in a light of a curious scientific phenomenon than being of any real practical utility.

OVIPOSITION.

Shortly after emergence from the egg and fertilization by the male, the female Trichogrammas are ready to commence depositing their eggs.

The following notes on the process are compiled from a large number of laboratory observations on many different individuals. In every case the proceeding was exact'y similar. On first being introduced into the tube containing the *Diatræa* eggs the female did not immediately discover their presence but appeared rather to come upon them by accidents in the course of its movements about the tube. This was repeatedly observed in a large number of cases and would indicate that the *Trichogramma* possesses no particular instinct which attracts them towards the eggs.* In confinement at any rate it may be definitely stated that in every case the eggs were discovered purely by accident. When the conditions in the average field of growing cane are taken into consideration—the immense quantity of foliage, the comparative rarity and obscurity of the egg masses of *Diatræa*, it seems indeed remarkable that the parasites should find the eggs at all. As soon as the parasite locates the eggs it at once becomes absorbed in their examination and never leaves the mass till—either oviposition is completed or else rudely disturbed.

Examination and oviposition is performed as follows:—The female *Trichogramma* at first moves in a nervously excited manner, rapidly and somewhat erratically over the surface of the eggs, scrutinizing them at the same time by means of innumerable tappings delicately and nimbly performed with the tips of both antennæ which are bent downwards for the purpose. This examination gradually becomes confined to one small area and as though to clear up finally

* A curious incident in this connexion was observed by the writer in Porto Rico early in 1913. A female *Diatræa saccharalis* was observed resting on the underside of a cane blade towards its base, on disturbing the moth a tiny insect emerged from beneath which on examination proved to be a *Trichogramma !*

all doubts as to the suitability of this proposed spot for oviposition it is tapped a number of times carefully and with regular intervals first with one antenna and then with the other. As soon as this is completed the insect moves forward till immediately over the selected spot when the ovipositor is gradually worked down through the somewhat tough egg shell.

As soon as the process of oviposition is commenced a curiously rigid and almost motionless attitude is taken up. The front part of the body is considerably raised by means of the fore legs, the hinder part being in close apposition to the surface of the egg. The hind pair of legs are stretched out slightly behind the body, the necessary purchase required to drive the ovipositor down through the outer covering of the egg being obtained by means of the front pair of legs. At the commencement of oviposition slight movements of the hinder part of the abdomen are to be observed due to the manipulation of the ovipositor. Invariably towards the end of the process a slight swaying movement of the whole body from side to side is to be seen, which gives the appearance of an effort required to withdraw the ovipositor. When the oviposition is almost completed slight movements of the antennae may at first be seen followed by a very sudden relaxation of the ovipositing attitude as though the insect was relieved at its termination.

Whilst engaged in the egg-laying process the Trichogramma is not easily disturbed, for on several occasions the eggs on which the parasite was operating were quite violently moved, without any effect, however. The singleness of purpose and entire absorbtion in the matter in hand is indeed quite characteristic.

Between 50 to 60 seconds is the average length of time required for oviposition, when ovipositing for the first time in an egg a longer period of time is taken than when ovipositing for the second or third time in the same egg. The time taken in examining the egg previous to oviposition, is generally about 40 seconds, though it varies with different individuals.

On one occasion a *Trichogramma* was observed ovipositing in the field and the proceeding was exactly similar to that described above. These insects do not appear to be able to distinguish parasitized eggs in their early stages from unparasitized ones. On several occasions when a *Trichogramma* was

supplied with eggs which had been very thoroughly parasitized some two days previously by another *Trichogramma* oviposition at once took place. Repeated attempts to persuade a Trichogramma to oviposit in eggs that had become black from parasitism proved a failure: in every case they were rejected after a short examination.

Not infrequently in the field egg masses are taken only a few eggs of which are parasitized, the others producing larvae. On one occasion in the laboratory several Trichogrammas repeatedly oviposited in the empty egg shells of Diatræa from which the larvae had recently emerged.

Parasitism of the eggs is only successful when taking place up to the seventh day after their deposition by the female moth.

LENGTH OF LIFE OF THE ADULT TRICHOGRAMMA.

The usual length of life of a female *Trichogramma* under laboratory conditions and when fed with syrup varies from 2 to 3 days. They have been kept alive in rare instance for as long as 5 days.

NUMBER OF EGGS DEPOSITED BY TRICHOGRAMMA.

Some idea as to the capability of Trichogrammas in this respect may be gained by the following experiments carried out under laboratory conditions.

A female parasite, known to have been fertilized by a male, was placed with an egg mass of *Diatræa* consisting of 10 ova freshly deposited. In these it oviposited 38 times. It was then removed and placed with another fresh egg mass of 11 eggs, in which it oviposited 42 times. It was removed from these and placed with another batch of 14 eggs, being supplied with syrup at the same time, on which it fed. By this time it began to show very evident signs of exhaustion and only oviposited 6 times in these eggs finally moving off them and remaining motionless. The following morning it was observed to be in the same position but on being disturbed it commenced to oviposit once more, but after the 9th operation it ceased altogether. It was not seen to oviposit the rest of that day and next morning was found to be dead. This female altogether oviposited 95 times which eventually produced 71 adult parasites. In another case a *Trichogramma* oviposited 47 times in a batch of 15 *Diatræa* eggs, 41 times in a batch of

6 eggs, and 12 times in a batch of 5 eggs, all on the same day. She refused to oviposit again and died during the course of the following day. This female oviposited altogether 100 times, which eventually produced 80 adult parasites.

BEHAVIOUR OF PARASITIZED EGGS.

Three days after being parasitized by *Trichogramma* the *Diatræa* eggs commence to change colour. The usual light yellow colour turns to a grayish tint and tiny black marks may be observed round the edges of the eggs. In just under four days the eggs have turned completely black, and in nine days the parasites are fully developed and emerge. These results are from numerous observations made under laboratory conditions at a temperature varying from 79° F. to 87° F., and in dry weather.

DEVELOPMENT OF THE PARASITE IN INFERTILE DIATRÆA EGGS.

From the few observations that have been made on this point, it appears that, owing to the drying up of these eggs soon after deposition, parasites are not capable of developing therein. It is probable that under natural conditions infertile eggs are seldom if ever produced so that this point is not of any economic value.

THE PROPAGATION OF THESE PARASITES.

All these observations very plainly demonstrate the extreme usefulness of these tiny insects and consequently every effort should be made by planters to maintain their numbers and if possible to artificially increase them. In this connection it may be mentioned here that the practice of burning the trash in canefields previous to the cutting of the cane cannot but result in the destruction of a large number of these valuable insects.

A number of estates employ small gangs of specially intelligent children for the collection of the egg-masses of Diatræa among young canes, directions being given that only the yellow eggs are to be collected, the blackened ones showing parasitism being left in the field. This is not altogether a satisfactory method for apart from the dificulties of getting these children to realize the differences between the various conditions of the eggs, it often happens that the yellow eggs when collected have been parasitized though showing no signs of parasitism which, as we have already

seen does not commence to appear till some three to four days after parasitism by the *Trichogramma*. In the majority of cases the egg masses collected by these gangs are destroyed at the end of the day, and it is quite probable for the above mentioned reasons that the practice results in as much harm as it does good. Keeping these collected masses in trays surrounded by water so as to prevent the escape of the caterpillars and to allow the parasites to escape, to be in any degree successful must be performed in close proximity to the canefields. Also under these circumstances the emerging caterpillars contract a habit of feeding on the unhatched (either parasitized or unparasitized) eggs. The following method of handling the collected eggs is an extremely simple one and will be found to give good results if handled by a competent individual.

The egg masses when collected are brought back to the buildings, placed in a light tight wooden box into the sides of which are let in clear glass tubes. A convenient size for such a box is 20 x 6 inches with 4 tubes 6 inches in length and 1 inch in diameter let into either side (see illustration). Such a box is easily constructed and the sizes given may not necessarily be adhered to. A strong cardboard box with a tight fitting lid is a very efficient substitute. Any parasites emerging from the contained eggs will at once make their way to the light and will consequently enter these tubes, also any larvæ that emerge will do the same. The tubes containing parasites or larvae may easily be removed from the box, plugged with cotton wool and taken to the canepiece where the parasites may be liberated. A fresh tube is then put in place of the one containing the parasites *

The egg masses in the box may be picked over from time to time and eggs from which parasites or larvae have emerged, removed. It is important that this box be kept on a table standing in oil to keep off ants.

The only drawback to this method is the possibility of distributing hyperparasites or parasites that live on the parasites themselves, along with the *Trichogramma*.

*The writer has seen boxes of this description used in the United States for the successful rearing of parasites. Mr. F. W. Urich, Entomologist to the Board of Agriculture, Trinidad, has recommended a similar contrivance for the rearing of parasites from the eggs of the froghopper.

Large numbers of these egg parasites of *Diatraea* from various localities have recently been examined in this laboratory but up to the present no traces of hyperparasites have been met with. A constant watch however is being maintained.

A Hint for a New Vegetable.

The flowerbuds of the banana are extensively used as a vegetable in all parts of the Philippines.

—"Agricultural Review," Philippine, July, 1912.

Bamboo for Paper-making.

During recent years much work has been done on the utilisation of bamboos for paper-making. In 1903 the subject was studied by R. W. Sindall, who visited Burma on behalf of the Government of India and issued an official report, entitled *The Manufacture of Paper, and Paper Pulp in Burma*. . . . Further investigations have been carried out recently by W. Raitt, whose report is published in *The Indian Forest Records* (1912, 3, part III, 1). The work was restricted to the following species: *Bambusa arundinacea*, Willd.; *B. Tulda*, Roxb.; *B. polymorpha*, Munro; *Cephalostachyum pergracile*, Munro; and *Melocanna bambusoides*, Trin. The results indicate that all these five species are suitable for pulp manufacture, provided that the stems can be delivered at the mill at a cost not exceeding £1 per ton of air-dry bamboo. The stems of all ages may be mixed indiscriminately, and there is no need for the nodes to be cut out and rejected as has been asserted previously. If desired, stems of all the species, except Melocanna, may be treated together. The various difficulties which have been experienced hitherto may be all overcome by observing the following points. The stems should not be cut until the shoots of the year are fully grown, as at this period the amount of starch present is at a minimum. An interval of three months should be allowed to elapse before the stems are used, in order that they may become seasoned. The stems should be crushed before being placed in the digesters; this obviates the necessity of cutting out the nodes, saves two hours in the time required for digestion, allows a weaker solution to be used, thus reducing loss of fibre by hydrolysis, and gives a more evenly digested product. The starchy matter should be extracted by a preliminary treatment with hot water. The sulphate process of digestion should be employed. It is estimated that a ton of unbleached pulp could be produced at a total cost of £6 3s. 4d., whilst the market value of unbleached European wood-pulp, landed in Calcutta, is £9. 16s. per ton.

—Bulletin of the Imperial Institute, December, 1912.

Insects Injurious to Sugar Cane in Porto Rico, and their Natural Enemies.

By D. L. Van Dine,
(Entomologist, Experiment Station, Porto Rico Sugar Producers' Association, Rio Piedras.)

[The following list of Insects injurious to Sugar Cane in Porto Rico, and their Natural Enemies, compiled by Mr. D. L. Van Dine, Entomologist, Experimental Station, Porto Rico Sugar Producers' Association, is of particular interest with regard to the various sugar pests we have in this colony. It will be observed that quite a large number of the natural enemies have been introduced into the Island—a line of work which might well be undertaken in British Guiana.—G. E. B.]

(1.) *Diatræa saccharalis* Fabr.

Determined by Dr. H. G. Dyar of the United States Bureau of Entomology.

Common Name : The sugar cane moth stalk-borer.

Natural Enemies :

Local :

The fungus parasite, *Cordyceps barberi.*
Determined by Dr. R. Thaxter of Harvard University.

An egg parasite, *Trichogramma pretiosa* Riley. (?)

A Tachinid fly, *Tachinophyta* (*Hypostena*) sp. Determined by Mr. W. R. Walton of the United States Bureau of Entomology.

Introduced :

An egg parasite (*Trichogramminae*) undetermined. From the Laboratory of the United States Bureau of Entomology, Audubon Park, New Orleans, La.

(2.) *Lachnosterna* spp.

Undetermined.

Common name : May-beetle or white-grub.

Natural Enemies :

Local :

The wasp, *Campsomeris dorsata* Fabr. Bred from larvae.

Determined by Mr. S. A. Rowher of the United States Bureau of Entomology.

The wasp, *Elis sexcincta* Fabr.
Adults collected from flowers.
Determined by Mr. Rowher.

Cryptomeigenia aurifacies Wash. Ent., Soc. xiv., 1912, No. 4 198-201 plate *Eutrixoides jonesii* Ent. News., xxiv., 1913, No. 2 49-52.

Tachina flies, *Cryptomeigenia* sp. and *Eutrixa*. Bred from adults.

Described by Mr. W. R. Walton.

Blackbirds, *Crotophaga ani* and *Holoquiscalus brachipterus*.

Determined by Prof. H. W. Henshaw of the United States Biological Survey.

Lizards (*Sauria*).

According to Stejneger (The Herpetology of Porto Rico, 1904, p. 599) there are no less than 19 species of this sub-order of Reptilia in Porto Rico.

Introduced :

The wasp, *Tiphia inornata*, Say. from Illinois.

Evidence indicates that this fungus is already established in the Island.

The fungus, *Metarrhizium anisopliae* from the Hawaii Board of Agriculture, Honolulu.

The fungus, *Isaria densa*, from France.

The common American toad, from Texas, through the United States Bureau of Entomology.

(3.) *Scapteriscus didactylus* Latr.

Common Name : Mole-cricket.

Natural Enemies :

Local :

The blackbirds and lizards noted under (2).

Introduced :

The common American toad noted under (2).

(4.) *Pseudococcus sacchari* Ckll. and *P. calceolariae* Mask. (?)

Determined as (?) by Mr. E. R. Sasscer of the United States Bureau of Entomology.

Common Name : The sugar-cane mealy-bug.

Natural Enemies :

Local :

The fungus parasite, *Aspergillus* sp.

Determined by Mr. J. R. Johnston, pathologist of the Station.

Introduced :

The Australian ladybird beetle, *Cryptolæmus montrouzieri* Muls., from California, through the United States Bureau of Entomology.

Associates :

The fire-ant (Hormiga brava), *Solenopsis geminata* and *Prenolepis fulva* Mayr.

Determined by Dr. Wm. M. Wheeler of Bussey Institution.

(5.) *Delphax saccharivora* Westw.

Determined by Mr. O. Heidemann of the United States Bureau of Entomology.

Common Name : The West Indian sugar-cane leaf-hopper.

Natural Enemies :

Local :

An egg parasite, *Mymaridae*, undetermined.
An external parasite, *Dryinidae*, undetermined.
A stylop, *Strepsiptera*, undetermined.

(6.) *Metamasius hemipterus* Linn.

Determined by Mr. E. A. Schwarz of the United States Bureau of Entomology.

Common Name : The West Indian sugar-cane weevil stalk-borer.

(7.) *Diaprenes* sp.

Determined by Mr. E. A. Schwarz.
Common Name : The sugar-cane weevil root-borer.
Note : Not the sugar-cane weevil root-borer of Barbados.

(8.) *Sipha graminis* Klt.

Determined by Mr. Theo. Pergande of the United Bureau of Entomology.

Common Name: The sugar-cane aphide.

Natural Enemies:

Local:

The ladybird beetles, *Cycloneda sanguinea* Linn, *Megilla innotata* Vauls., *Scymnus loewii* Muls., and *Scymnus roseicollis* Muls. Determined by Mr. E. A. Schwarz.

A Syrphid fly, undetermined.

A Chrysophid, undetermined.

Also a second species of Aphid (undetermined).

(9.) *Xyleborus* sp.

Determined as representing a new species by Dr. A. D. Hopkins of the United States Bureau of Entomology.

Common Name: The sugar-cane shot-hole stalk-borer.

(10.) *Dynastides.*

Ligyrus sp.

Common Name: The hard-back beetle.

Several species, undetermined.

Common Name: Rhinoceros beetles.

(11.) *Laphygma frugiperda* S. and A.

Determined by Dr. H. G. Dyar.

Common Name: The southern grass-worm.

Natural Enemies:

Local:

Frontina archippivora Will.
Archytas piliventris V. de W.
Gonia crassicornis Fab.

Tachina flies, bred from larvae. Determined by Mr. W. R. Walton.

(12.) *Remigia repanda* Fab.

Determined by Dr. H. G. Dyar.

Common Name: The grass-looper.

Natural Enemies:

Local:

Tachina flies from larvae.

(13.) *Cirphis latiuscula* H. S. (Noctuidae.)
Determined by Dr. H. G. Dyar.
Common Name: Noctuid.

Natural Enemies:

Local:

Braconid parasite bred from larvae.

(14.) *Prenes nero* Fabr. (Hesperidae.)
Determined by Dr. H. G. Dyar.
Common Name: Skipper.

(15.) *Targonia sacchari* Ckll.
Determined by Mr. E. R. Sasscer.
Common Name: The sugar-cane scale-insect.

(16.) *Diabrotica graminea* Balz.
Determined by Mr. E. A. Schwarz.
Common Name: The green Diabrotica.
Note: Breeding habits not known. Adult injurious to sugar-cane leaves.

(17.) *Tettigonia similis* Walk. (Jassidae.)
Determined by Mr. O. Heidmann.
Common Name: Jassid.
Note: Breeding habits not known.

(18.) *Ormensis* sp. (Fulgoridae.)
Determined by Mr. O. Heidmann.
Common Name: Leaf-hopper.

(19.) *Tineidae.* Undetermined.
Common Name: Bud-moth.

(20.) *Termitidae.* Undetermined. (Stahl, 1882. *Termes morio* Loth.)
Common Name: White-ants or Termites.

(21.) *Crustacea.* Undetermined.
Oniscidae. (Isopoda.)
Common Name: Pill-Bug.
Cancridae. (Decapoda.)
Common Name: Land crab.

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on Tuesday, May 6, at the offices of the Board, Broad Street, Professor Harrison (Chairman), presiding. There were present Mr. A. Leechman (acting Deputy Chairman), the Hon. J Downer, Messrs. F. Fowler, O. Weber, J. Gillespie, H. L. Humphrys, S. H. Bayley, W. M. Payne, C. P. Gaskin, J. W. Davis, T. Earle, J. F. Waby, G. E Bodkin, J. A. Raleigh, R. Ward and E. S. Christiani (Secretary).

The Chairman referred to the great loss the Board had sustained by the death of Mr. B. Howell Jones, C.M.G. The late member had done much service to agriculture in the colony, especially with regard to subsidiary industries and stock-keeping.

A motion by the Chairman that the Board record on its minutes its very deep regret at the loss it and the colony had sustained, and forward a copy of the resolution to Mrs. Howell Jones with an expre sion of their deep sympathy, was seconded by Mr. Gaskin and carried unanimously.

A despatch from the Secretary of State advising the Government of the abolition of the office of Adviser to the Colonial office (held by Sir Daniel Morris, K.C.M.G., D.Sc) on tropical agriculture was laid on the table.

A motion by Mr. Davis that the Board place on their minutes their deep regret at the retirement of Sir D. Morris, was seconded by Mr. Downer and carried unanimously.

It was resolved to forward a copy of this motion to Sir Daniel Morris through the Government Secretary.

A suggestion by the Chairman that the Board enter into further negotiations concerning the manurial experiments with coconuts at Pln. Grove was agreed to, and it was decided to defray the costs of experiments from the $1,000 vote provided for contingencies.

The Chairman reported that the census returns of minor agricultural industries for 1912-13, though not complete, indicated a falling-off in the area under some products. The acreage in rice had indeed increased from 36,000 to 41,100, and coconuts, (which had increased by 2,000) were now 14,000;

but cacao showed a decrease of some 300 acres and coffee returns were lower. Rubber showed an increase of about 800 acres, limes worked out at 739 acres compared with 658, ground provisions kept the same position, (18,000 acres) live stock fell off to nearly 15,000 head; sheep were reduced by 2,000; goats had diminished, pigs were less but donkeys were more.

The Chairman said the Veterinary Committee had had a circular drawn up describing the common symptoms of glanders and of glanders and farcy.

It was reported that the "farm competition" on the lower East Coast had been examined from time to time and the judges were struck by the marked difference existing between the various farms.

THE "GINGER LILY" AS PAPER PULP PRODUCER.

The Chairman reported that he had been directed by His Excellency to bring forward a proposal from Kew regarding the cultivation of *Hedychium*, known in this colony as the "ginger lily," which supplies paper pulp of very high quality and value. The plant grew wonderfully in Brazil but as there was a possibility that the "ginger lily" growing here might not be as vigorous as that growing in Brazil, he had, on Mr. Waby's advice, asked the Governor to import some tubers from Brazil and they would plant them out in certain swampy places and see how they grew.

The Chairman notified the Board that some areca nut seeds received from the Governor had been planted in the Nursery. His Excellency had been struck by the inferior growth of the palms here compared with those in Nigeria. He thought that His Excellency's plan of getting fresh seeds from the place where they did well would be very useful in supplying definite information as to the cause of and as a remedy for this inferiority.

Mr. Payne moved that the cultivation of the castor oil plant be encouraged by the Board, and as an incentive to cultivators a bonus of $50 be given for the best cultivation of five acres.

The motion being opposed by Mr. Humphrys, who thought the premium was too small, Mr. Payne accepted the suggestion of Mr. Davis that experiments be made by the Department of Agriculture to ascertain the most suitable soil and seed; and

that with the publication of the results people would be free to engage in cultivation irrespective of a bounty.

The motion was taken as a recommendation.

The sales of economic plants at the various centres were: Georgetown (Market stall), 2,386; New Amsterdam, 682; Pomeroon, 112; Suddie, 23; Morawhanna, 377.

THE VALUE OF LOCAL RUBBER.

With regard to the experimental tappings of the 4 to 5 years old Para rubber trees at the North West station the Chairman said that the results were satisfactory so far as the brokers' report went. The biscuit rubber was valued within 1½d. a pound of hard Para rubber. Para scrap being worth 3s. a pound, the local scrap was valued at 3s. 3d.

The Chairman intimated that every estimate obtained in respect of the establishment of a small citrate factory operating on 100 acres at Onderneeming increased its cost, until it had risen to from £800 to £1,000 which was more than double the amount they thought would have effected the purpose.

After considerable discussion the Board concluded that a factory was necessary; and on the motion of Mr. Davis it was agreed to ask the Combined Court for a sum not exceeding $5,000 for the erection and equipment of such a factory.

Owing to the petition of several owners of motor-cars and the approval which His Excellency and every member of the Executive Committee showed of the idea, the Board decided to annul the regulation restricting motor traffic to the main road of the Botanic Gardens and substituted another providing for a limit of speed not exceeding 10 miles per hour on all roads in the Gardens except the narrow interlacing roads in the western, or flower, garden.

The Victoria-Belfield Agricultural Society applied for a grant-in-aid for a show in August instead of a farmers' competition. The Board was of opinion that the farmers' competition was of more value than a show, and recommended a grant of $120 for such competition.

Grants of $150 each were recommended to be made to the Buxton and Friendship Farming Association and the West Bank Farmers' Associations for Shows in those Districts.

RESULTS OF LIVE STOCK SALE.

The returns of the recent live stock sale showed that cattle from Onderneeming realised $768, those from the Orphan Asylum $68, and those from the Penal Settlement $448.

The Board approved of the importation this year of a stallion donkey.

It was reported that a stock of Plymouth Rock fowls, comprising 9 hens and 3 cocks had been imported. They arrived at Onderneeming on the 31st October, and at present there were 156 chickens, ranging from a week to five months old, while the hens were still laying.

It was decided that sales should be made of the eggs and some of the young fowls, the p ices to be fixed by the Executive a Committee of the Committee appointed for that purpose.

Messrs. Sandbach Parker & Co. having applied for compensation for two mules destroyed as suffering from glanders, the Chairman pointed out that the animals were destroyed without an order from the Board. It was agreed after some discussion to recommend the payment of $180—half the sum claimed.

A resolution was also passed instructing the Government Veterinary Surgeon in every case where infectious or contagious disease was notified, to visit the place and examine the diseased animal without waiting to be summoned by the owner; and if the animal was in a condition necessitating slaughter the Veterinary Surgeon to make an estimate of the cost and include it in his report.

The Cause of "Clover Sickness."

The old idea that clover sickness is due to the exhaustion of some soil constituent essential for the growth of clover is now disproved, and it has been definitely shown that the disease is of parasitic origin. Unfortunately two distinct parasites are equally capable of promoting the disease; the one being an "eelworm," *Tylenchus devastatrix* Kühn, and the other a fungus called *Sclerotina trifoliorum*, Eriksson.

—The Journal of the Board of Agriculture, (England)
February, 1913.

Hints, Scientific and Practical.

Para Rubber Trees and Bordeaux Mixture.

THE use of Bordeaux mixture on Para trees which are in bearing requires most careful attention in order to prevent the contamination of the latex by copper, salts of copper having a toxic action on prepared rubber. It is for this reason perhaps preferable to employ a lime-sulphur mixture. Up to quite recently it has not been possible to use a sulphur mixture owing to the fact that the more powerful spraying machines were made of copper which becomes badly corroded by the sulphur.

—C. K. Bancroft, M.A., F.L.S. in the "Agricultural Bulletin of the Federated Malay States," January, 1913.

Putrefaction and Decay.

IT is a matter of everyday experience that when organic substances or mixtures such as milk, wines, flesh products, or wood are exposed to ordinary atmospheric influences they undergo chemical change and become unwholesome or useless. At one time it was believed that those changes were due to instability in the complex chemical molecule, and that decay, therefore, was a spontaneous result. More modern investigation has shown this view to be wrong, and that the whole series of changes variously known as souring, rotting, decay, fermentation and putrefaction are caused by various low forms of life, especially by bacteria and moulds. As these latter are plants —bacteria are very small plants indeed—it will easily be understood why perishable commodities can be preserved in various ways. As all plants—including bacteria—require water, it will be seen that dried milk or dried fish can be kept indefinitely. Again, as all plants have a temperature at which they grow quickest—generally between 80 and 100 degrees F. —decay is quicker in warm weather. Then, again, each plant —including bacteria—has a temperature below which it cannot grow—usually between 32 and 50 degrees F.—therefore, freezing prevents decay. Boiling kills all sorts of plants, and a tin of meat sealed up while hot is free from bacteria and will keep indefinitely; but if a cold tin be opened decay soon starts because decay germs are floating about in the air. Again, plants may be poisoned just like animals, and antiseptics are things

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